

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

ATLAS GLOBAL TECHNOLOGIES LLC,

Plaintiff,

v.

ZYXEL NETWORKS CORPORATION
AND ZYXEL COMMUNICATIONS
CORPORATION

Defendants.

Civil Action No. 6:22-cv-00355-ADA

ATLAS GLOBAL TECHNOLOGIES LLC,

Plaintiff,

v.

D-LINK CORPORATION,

Defendant.

Civil Action No. 6:22-cv-00520-ADA

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I. INTRODUCTION

Plaintiff should not be permitted to retract the inventors’ statements or otherwise rewrite claims or expand their meaning beyond their proper scope, particularly when the inventors acted as their own lexicographers for the claim terms. Plaintiff wants the Court to focus on Plaintiff’s infringement theories. However, Defendants’ construction centers on the inventors’ statements and other intrinsic evidence critical for claim-construction issues. Plaintiff’s response (“P-Br.”) focuses heavily on the prior claim-construction arguments before this Court or the EDTX Court. Defendants here were not participants in the prior claim-construction proceedings. For the reasons discussed in Defendants’ Opening Brief (“Opening Br.”) and below, Plaintiff’s attempts to rewrite claims and definitions should be rejected.

II. ARGUMENT

A. U.S. Patent No. 9,531,520

1. “[a/the] network device” (claims 1, 6)

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
“[an/the] access point”	plain and ordinary meaning

Plaintiff fails to mention how Defendants present additional arguments that have not been before this Court. In view of the ’520 Patent inventors’ statements made in, for example, the priority applications and in the Amendment, Defendants respectfully request the Court to consider the additional arguments that the inventors acted as the lexicographer and to adopt Defendants’ proposed construction.

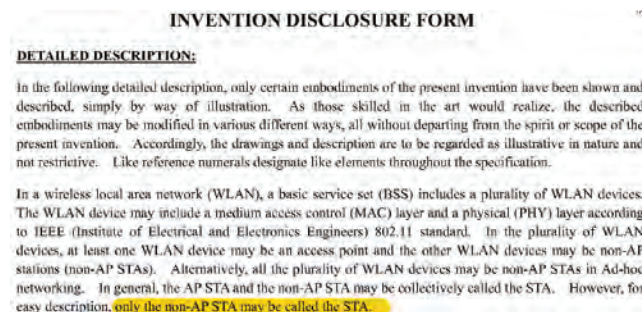
While ignoring the ’520 Patent inventors’ lexicography for the term, Plaintiff contends that “network device” is a “non-technical term that needs no construction.” P-Br. at 4. Yet, Plaintiff devotes its Introduction to explain, in a technical context, “Wi-Fi 6 networks generally include two types of devices: (1) Access Points (‘APs’)...; and (2) Stations (‘STAs’).” P-Br. at 2. Plaintiff’s Introduction highlights how the phrase “network device” can have a specific meaning, such as in

a particular technical context. As explained in Defendants' Opening Brief, Defendants' proposed construction properly reflects how the '520 Patent inventors, as the lexicographers, use the phrase "network device" in the context of claims 1 and 6.

More specifically, independent claim 1 recites and thereby requires "generating, by the network device, a downlink multi-user frame addressed to a *plurality of stations*." '520, 30:50-51 (emphases added). Portions of Claim 1 are reproduced with highlights to the right. By reciting "stations" as a separate and distinct phrase from "network device" in claims 1 and 6, the '520 Patent inventors elect to distinguish "station" from "network device." Therefore, the phrase "network device" must at least exclude "stations" in the context of claims 1 and 6.

1. A method, implemented by a network device in a wireless network, for coordinating an uplink multi-user response transmission to a downlink multi-user transmission, the method comprising:
generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and

Further, the '520 Patent inventors drafted independent claim 1 and dependent claim 6, as worded within these claims themselves, to equate "network device" and "access point." In fact, both the priority provisional applications to the '520 Patent (Provisional Appln. No. 62/137,138; Provisional Appln. No. 62/140,349) unequivocally state in the disclosure that "for easy description, only the non-AP STA may be called the STA." Ex 10A at ATLAS-00004113; Ex 10B at ATLAS-00004144.

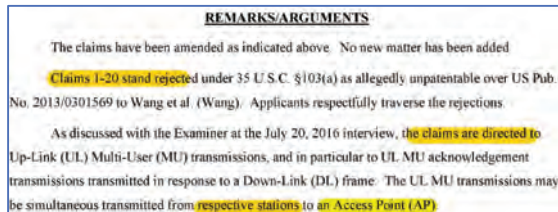


The relevancy of these statements cannot and should not be ignored as the '520 Patent inventors incorporate by reference the priority applications into the '520 Specification. '520, 1:8-15.

Although this statement does not spell out “network device,” the statements define the scope of the phrase “network device” in the context of claims 1 and 6. As mentioned in Defendants’ Opening Brief and above, the ’520 Patent inventors distinguished “station” from “network device” by reciting “a plurality of stations” as a separate and distinct phrase from “network device” in claims 1 and 6. In view of the inventors’ statements in the disclosure that “only the non-AP STA may be called the STA,” the phrase “network device” must at least exclude stations (i.e., non-AP STAs as defined by the inventors) in the context of claims 1 and 6.

Moreover, Plaintiff’s Introduction supports Defendants’ proposed construction. Since the ’520 Patent inventors unequivocally state in their disclosure that “only the non-AP STA may be called the STA,” a POSITA would understand Plaintiff’s statement that “Wi-Fi 6 networks generally include two types of devices: (1) Access Points (‘APs’)...; and (2) Stations (‘STAs’),” P-Br. at 2, to mean that in the context of Wi-Fi, devices are APs and non-APs. Because the ’520 Patent inventors elect to distinguish “station” from “network device” in claims 1 and 6, the ’520 Patent inventors effectively equate “network device” with “access point” in claims 1 and 6.

Also, the ’520 Patent inventors’ lexicography equating “network device” and “access point” is supported by the inventors’ arguments made in the July 22, 2016 Amendment. As acknowledged by Plaintiff, the ’520 Patent inventors did not use the term “network device” in their arguments to distinguish claims 1-20 from the cited prior art. P-Br. at 7. Instead, the ’520 Patent inventors use only “stations” and “an access point” in their arguments to respond to the claim rejection of claim 1. Plaintiff cannot deny that the inventors were addressing claim 1, which recited “network device.” That is, the inventors first specified their arguments pertained to the patentability of claim 1, which recited the phrase



“network device,” and then used only “stations” and “an access point” in their arguments to refute the claim rejection of all pending claims, including claim 1, thereby giving rise to prosecution disclaimer. Accordingly, the term “[a/the] network device” should be construed to mean “[an/the] access point.”

2. “acknowledgement information” (claims 1, 2, 4, 8, 9, 11, 12, 18, & 19)

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
“solicitation for information to be transmitted following receipt of the downlink multi-user frame to acknowledge the downlink multi-user frame”	plain and ordinary meaning

This phrase has not been before this Court. Here, Plaintiff and Defendants dispute the meanings of the ’520 Patent inventors’ own statements in the Specification. P-Br. at 8. ’520 Patent, Col. 14: 14-30 is reproduced the below with emphasis.

In one embodiment, one or more MPDUs may include acknowledgement information that is used for indicating to respective STAs a scheme/technique used to transmit acknowledgement messages to the AP. For example, in one embodiment, generation of one or more MPDUs addressed to each STA may include setting an acknowledgement policy subfield (ACK policy subfield) in a header of the one or more MPDUs (i.e., a MAC header) such that STA1 and STA2 can identify which technique/scheme is to be used by each non-legacy STA for acknowledging successful receipt of the MPDUs by each respective STA. In one embodiment, the ACK policy subfield is two bits and is located in the Quality of Service (QoS) Control Field of the MAC header. However, in other embodiments, the ACK policy subfield may be located in different portions of the MAC header and may be of a different length (e.g., 1 bit, 3 bits, etc.).

Plaintiff attempts to expand the phrase beyond the proper scope defined by the ’520 Patent inventors. Defendants submit that the phrases “in one embodiment” or “may” at Col. 14:13 pertain to MPDUs, and that the ’520 Patent inventors explicitly define “**acknowledgement information**” by stating “**that [it] is used for indicating to respective STAs a scheme/technique used to transmit acknowledgement messages to the AP.**” ’520, 14:16-18 (emphases added). Plaintiff has not countered with where the ’520 Patent inventors provide another definition for “acknowledgement information.” Accordingly, to properly reflect the patentee’s use of the phrase “acknowledgement information” in the ’520 patent, Defendants’ proposed construction should be adopted.

B. U.S. Patent No. 9,763,259

1. **“transmitting to the transmitting device a feedback frame including subchannel information measured on a first subchannel after receiving the NDP frame” (claim 1) / “receiving from each receiving device a feedback frame including subchannel information measured on a subchannel that is allocated to each receiving device among a plurality of subchannels into which a band is divided, after transmitting the NDP frame” (claim 18)**

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
“in response to receiving the NDP frame, transmitting to the transmitting device a feedback frame including subchannel information measured on a first subchannel one SIFS after receiving the NDP frame” (claim 1) “in response to and one SIFS after the transmitting of the NDP frame, receiving from each receiving device a feedback frame including subchannel information measured on a subchannel that is allocated to each receiving device among a plurality of subchannels into which a band is divided” (claim 18) If not construed as above, the terms are indefinite.	plain and ordinary meaning

These phrases have not been before this Court. Although Plaintiff contends the phrases have ordinary meanings, Plaintiff expressly concedes the disputed phrases do not read on every embodiment of the ’259 Patent. For example, Plaintiff acknowledges and concedes that the disputed claim phrases do not pertain to FIG. 7. P-Br. at 10. Notably, FIG. 7 is the first disclosed embodiment of “sounding procedure” in the ’259 Patent. Plaintiff’s own exclusion of FIG. 7 from the disputed phrases simply highlights how a POSITA would not have known with reasonable certainty, *inter alia*, whether the disputed claim phrases are related to the immediately preceding step of “receiving/transmitting a null data packet (NDP) frame,” or whether the feedback frame could be transmitted/received based on different NDP frames or some other triggers.

Further, although Plaintiff contends the disputed phrases have ordinary meanings, Plaintiff actually proffers a specific construction for the term “feedback frame” within the disputed phrases. See P-Br. at 11(reproduced below with highlights).

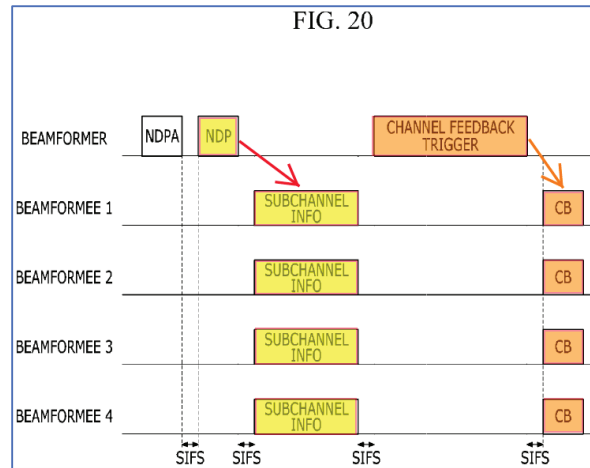
frames: (1) a Null Data Packet Announcement (“NDPA”) frame and (2) a responsive feedback frame (a/k/a, the compressed beamforming or “CB” frame). DX 2 (‘259) at 22:36-37, 40-45. And

Instead of admitting that the ‘259 Patent inventors acted as lexicographers, Plaintiff attempts to expand the disputed phrases as described by the ‘259 Patent inventors. For example, the requisite condition of “after [receiving/transmitting the NDP frame]” is consistently used throughout the ‘259 Patent to signify an immediate and direct logical and temporal relationship. *See, e.g.*, ‘259, 9:15-17; 9:22-44; 16:59-62; 16:66-17:5; 17:6-8; 32-34; 18:7-10; 18:35-38; 18:55-57. However, Plaintiff now improperly asserts that the CB frame transmitted after and in response to the Channel Feedback Trigger frame illustrated in the ‘259 FIG. 20 would be covered by the disputed phrases.

First, Plaintiff’s argument about whether the disputed phrases would cover FIG. 20 seems to be more related to non-infringement, not claim construction, and should be rejected by the Court. In any event, Plaintiff’s interpretation of FIG. 20 highlights how Plaintiff’s proposed construction attempts to improperly expand the claim scope to cover *any feedback frame* transmitted/received any time after the NDP frame. Plaintiff’s arguments based on FIG. 20 implicitly begs the Court to provide specific construction for the disputed phrases. Without a clarifying construction, the claim language (e.g., “after receiving the NDP frame”) is unclear and unbounded to any feedback frame and any time after the NDP frame. For example, do the disputed claim phrases refer to parallel¹ feedback frames being transmitted in response to the NDP frame (as in FIG. 24) or just any undefined time “after receiving the NDP frame” (e.g., an hour) with no logical relationship to the NDP frame (e.g., based on a different NDP frame or something different altogether)?

¹ Plaintiff argued that FIG. 7 is irrelevant to the disputed phrases by focusing on another phrases in claims 1 and 18, for example, “wherein the plurality of feedback frames from the plurality of receiving devices are received at a same time,” set forth in claim 18 (emphasis added). Regardless, Plaintiff concedes claims 1 and 18 require multiple, parallel feedback frames.

In fact, the '259 Patent inventors illustrate in FIG. 20 multiple, parallel “SUBCHANNEL INFO” frames transmitted/received *in response to* receiving/transmitting the NDP frame *and* one SIFS *after* receiving/transmitting the NDP frame. However, Plaintiff now discounts the “SUBCHANNEL INFO” frames illustrated in FIG. 20 as “intervening steps” based on the word “comprising” in the claim preamble. Notably, the word “comprising” is not in the disputed claim phrases. The inventors’ use of the word “comprising” in the claim preamble is not to make provisions for “intervening” frames/events between “a feedback frame” and “after receiving the NDP frame.” Plaintiff’s arguments based on the claim preamble should be rejected.



Defendants further request that the Court reject Plaintiff’s construction for the term “feedback frame.” P-Br. at 11. The '259 inventors explicitly describe and define “[e]ach beamformee device **measures a plurality of subchannels based on the NDP frame** and transmits **a subchannel information frame including measured information for each of the plurality of subchannels**. . . . In some embodiments, the beamformee devices may transmit the subchannel information frames in parallel.” ’259 Patent, 18:11-17 (emphases added). Plaintiff’s construction for “feedback frame”—“aka the compressed beamforming frame”—would improperly exclude the disclosed “subchannel information frame.”

Accordingly, the Defendants’ proposed constructions should be adopted. Otherwise, without a particular construction in light of particular embodiments disclosed in the specification, these claim phrases are indefinite under 35 U.S.C. § 112, ¶ 2.

2. “wherein the NDPA frame indicates information corresponding to the predetermined length” (claim 6)

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
indefinite	plain and ordinary meaning

Plaintiff relies on the discussion of “the maximum CB length” to remedy the unclear and unbounded term “the predetermined length.” Plaintiff argues that the ’259 Specification provides that the NDPA frame need not explicitly state the precise length of the subsequent CB feedback frame, but rather may include information on the maximum CB length. P-Br. at 12. First, as noted in Part II.B.1 above, in attempting to remedy the unclear and unbound phrase, Plaintiff actually proffers a specific construction for the term “feedback frame” within the disputed phrase. See P-Br. at 11. The fact that Plaintiff had to provide a special construction undermines Plaintiff’s position that there is a plain-and-ordinary meaning for the disputed phrase.

Additionally, Defendants request that the Court reject Plaintiff’s construction for the term “feedback frame.” P-Br. at 11. The ’259 Patent inventors explicitly describe that “[e]ach beamformee device **measures a plurality of subchannels based on the NDP frame** and transmits **a subchannel information frame including measured information for each of the plurality of subchannels.**” ’259 Patent, 18:11-14 (emphases added). Plaintiff’s construction for the term “feedback frame”—“aka the compressed beamforming frame”—would improperly exclude the “subchannel information frame” disclosed and defined by the ’259 Patent inventors.

Also, as presented in Defendants’ Opening Brief, a POSITA would not have understood what is, and what is not, encompassed within the scope of the phrase “indicates information corresponding to.” See Opening Brief, Roy Decl., ¶¶ 29-32. However, to the extent the Court believes that this term is not indefinite, Defendants respectfully submit that this term should be

given its *actual* plain-and-ordinary meaning, in which the NDPA frame includes information on the maximum feedback frame length.

C. U.S. Patent No. 9,825,738

1. **“transmitting the downlink data and the uplink setup information in a single physical downlink frame to a plurality of stations” (claim 1) / “the physical downlink frame comprising: uplink setup information including a first information to be used for uplink multi-user transmission by the station, and downlink data” (claim 9)**

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
“transmitting the downlink data and the uplink setup information in a single physical downlink frame to a plurality of stations, wherein the uplink setup information is that which would otherwise be in an uplink setup or uplink initiation (ULI) frame, and the downlink data is data other than the uplink setup information” (claim 1) “the physical downlink frame comprising: uplink setup information including a first information to be used for uplink multi-user transmission by the station, and downlink data, wherein the uplink setup information is that which would otherwise be in an uplink setup or uplink initiation (ULI) frame, and the downlink data is data other than the uplink setup” (claim 9)	plain and ordinary meaning

Once again, Plaintiff contends the disputed phrases have ordinary meanings. Yet, Plaintiff proffers a specific construction in the ’738 Patent for the term “uplink setup information” within the disputed phrases. See Pl. Expert Dec., ¶ 49 (reproduced partially below with emphases).

49. With regard to “uplink setup information,” the ’738 patent and claims recite the salient features of that information, which is used for initiating a multi-user uplink transmission from a plurality of stations. The uplink setup information includes “first information to be used for uplink multi-user transmission by the plurality of stations” that receive the uplink setup information.” ’738 Claim 1 at 24:57-59, Claim 9 at 25:40-42. The claims also require that the uplink setup information includes a common information portion that includes second information common to the plurality of stations that receive the uplink setup information and a dedicated portion with third information specific to each of the plurality of stations. ’738 Claim 1 at 25:1-8; Claim 9 at 26:7-14. The ’738 specification is consistent with the claims, describing both a common

Consistent with Defendants’ proposed construction reflecting “uplink *initiation* frame,” Plaintiff first acknowledges and defines the term “uplink setup information” to mean (i) “information for *initiating* a multi-user uplink transmission from a plurality of stations.” *Id.* Plaintiff further defines “uplink setup information” to mean (ii) information to be used for uplink multi-user transmissions sent simultaneously by a plurality of stations; and which includes (iii) a common portion; and (iv) a dedicated portion. *Id.* If the Court declines to adopt a plain-and-ordinary-meaning construction, Defendants respectfully submit that the Court should give “uplink setup information” its meaning as admitted by Plaintiff: “information that (i) provides information for initiating uplink multi-user transmissions sent simultaneously by a plurality of stations; (ii) provides information to be used for the uplink multi-user transmissions sent simultaneously by the plurality of stations; (iii) includes a common portion; and (iv) includes a dedicated portion.” Pl. Expert Dec., ¶ 49.

2. **“the second information is a function of a total number of space time streams to be used to transmit the multiple uplink frames” (claim 1) / “the second information is a function of a total number of space time streams to be used to perform the simultaneous transmission of the uplink frame and the one or more uplink frames from the one or more other stations” (claim 9)**

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
indefinite	plain and ordinary meaning Alternatively, “The second information in the common information portion is a value that is related to the total number of space time streams to be used to transmit the multiple uplink frames” (claim 1) / “the second information in the common information portion is a value that depends on the total number of space time streams to be used to simultaneously transmit the multiple uplink frames” (claim 9)

Plaintiff relies heavily on extrinsic evidence (dictionaries and expert opinions). P-Br. at 16. Plaintiff cites only one example in the intrinsic record and argues that “a function” means it “may be determined in accordance with [the number of space time streams].” P-Br. at 17

(reproduced partially below with emphasis).

may be determined in accordance with (i.e., is a function of) **the number of space time streams:**

The fact that Plaintiff explains the term “function” as “**may** be determined” affirms the indefiniteness of the disputed phrases. Moreover, Plaintiff and Plaintiff’s expert merely replace “function of” with the equally unknown and unbounded “may be determined in accordance with.” Notably, any number could be written as a “function of the number of space time streams” in Plaintiff’s proffered “corresponding” table on page 17 of its brief, so a POSITA is still unable to determine whether, for any particular number, the claim is infringed.

In short, Plaintiff still fails to cite any intrinsic or extrinsic evidence to identify any particular formula that employs a “function” of the total number of space time streams. Without an explanation of the “function,” the claim lacks any reasonable certainty, and a POSITA cannot determine whether the “second information” satisfies the claim’s requirement that it “is a function of the total number of space time streams.” From the perspective of a POSITA, this would not resolve the fact that the scope of the claim is uncertain. See Opening Brief, Roy Decl., ¶¶ 34-36. Accordingly, Defendants respectfully submit that these terms in claims 1 and 9 are indefinite.

D. U.S. Patent No. 9,848,442

1. “a mode that is High Efficiency” / “a mode of a standard previous to a standard defining the High Efficiency mode” (claims 1, 8)

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
indefinite	“a mode specified as High Efficiency (HE) by an 802.11 Standard or proposed 802.11 Standard” “a legacy mode specified in a IEEE 802.11 Standard released prior to 802.11ax standard or proposed standard (e.g., a non-HT, a HT, a VHT)

The subject claim phrases do not appear in the patent specification. Plaintiff relies heavily on extrinsic evidence (expert opinions) and then improperly equates the disputed phrases “a **mode**

that is High Efficiency” with “High Efficiency (HE) **frames**” in the context of 802.11ax (as existed or understood as of the effective filing date of the ’442 Patent). P-Br. at 19. However, “it is not [the Court’s] function to rewrite claims to preserve their validity.” *Synchronoss Techs., Inc. v. Dropbox, Inc.*, 987 F.3d 1358, 1367 (Fed. Cir. 2021) (quoting *Allen Eng’g Corp. v. Batell Indus., Inc.*, 299 F.3d 1336, 1349 (Fed. Cir. 2002)). Also, the ’442 Specification expressly was **not** limited to the 802.11 WLAN standard. *See, e.g.*, ’442 Patent at 4:18-22 (“The WLAN device **may** include a [MAC] layer and a [PHY] layer according to IEEE [] 802.11 standard.” (emphasis added)); 15:29-32 (“[V]arious changes, substitutions, and alterations may be made herein without departing from the scope of the disclosure”); 4:7-14. As noted in Defendants’ Opening Brief, the disputed claim phrases make no reference to *any* 802.11 standard, and the Court should reject Plaintiff’s improper attempt to incorporate such limitations into the plain language of the claim. Should the Court adopt Plaintiff’s construction despite the improper imported limitations from the IEEE 802.11 standard, the Court should nevertheless reject the parenthetical portion of the construction providing non-limiting examples, as it is not definitional and would not be helpful to a jury.

In addition, Plaintiff’s focus on the single example in the specification where it alleges that the mode “that is High Efficiency” exclusively refers to 802.11ax (as existed or understood as of the effective filing date of the ’442 Patent) (P-Br. at 18), even if accepted as true, fails to acknowledge the Specification’s language that this embodiment is only one example. ’442, 12:4-7 (explaining that Fig. 10 explains “a method for controlling transmission opportunities of a WLAN device according to an **exemplary embodiment** of the present disclosure.” (emphasis added)). The Federal Circuit has consistently held that “particular embodiments appearing in the written description will not be used to limit claim language that has broader effect” unless certain exceptions apply. *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111,

1117 (Fed. Cir. 2004); *see also Comark Comm's, Inc. v. Harris Corp.*, 156 F.3d 1182, 1186 (Fed. Cir. 1998). For example, in *Innova/Pure Water*, the Federal Circuit found the district court inappropriately limited claims based on examples in the specification. 381 F.3d at 1118.

Plaintiff also fails to identify **any** objective boundary in the '442 Patent (or elsewhere) by which a POSITA would know whether the efficiency of a given (or future) WLAN's mode is high "enough" to meet the "high efficiency" limitations of the asserted claims. Plaintiff improperly argues that capitalizing the term makes it a "proper noun." P-Br. at 20. However, as noted above, the disputed claim phrases make no reference to *any* 802.11 standard, and the '442 Patent inventors did not limit it to 802.11 WLANs. Furthermore, the binary distinction between "a mode that is High Efficiency" and the variety of modes that are *not* "High Efficiency" does not render the line between those types of modes any less blurry to a POSITA. Even accepting Plaintiff's arguments—whether 802.11ax's later-standardized protocol, a future IEEE "802.11zz," or an alternative WLAN protocol meets a POSITA's understanding of this term as of the time of the '442 Patent's filing (compared to the then-proposed 802.11ax specification)—would be a factual issue for the parties to dispute. But without **any** objective yardstick to guide this dispute to define what makes a mode "High Efficiency," this term must be found indefinite.

2. **"when the BSS of the first PPDU is the BSS to which the first station does not belong, a received signal strength of the first PPDU is higher than a first threshold, and the first PPDU is a frame having a mode that is High Efficiency and having a PHY header that includes duration information for setting a virtual carrier sensing...; when... the received signal strength of the first PPDU is higher than the first threshold, the first PPDU is a frame having a mode of a standard previous to a standard defining the High Efficiency mode, and the first PPDU is a frame having a PHY header that does not include duration information for setting the virtual carrier sensing...; and when... the received signal strength of the first PPDU is lower than the first threshold" (Claims 1, 8)**

Defendants' Proposed Construction	Plaintiff's Proposed Construction
indefinite If not indefinite, the Court must determine whether only one of the claimed steps with mutually-exclusive conditions, or all three of the claimed steps with mutually-exclusive conditions, are required to occur for purposes of meeting the claim limitations.	plain and ordinary meaning

It is axiomatic that “[a] method claim is directly infringed when someone practices every step of the patented method.” *Ericsson, Inc. v. D-Link Sys., Inc.*, 773 F.3d 1201, 1219 (Fed. Cir. 2014) (citation omitted); *see also Limelight Networks, Inc. v. Akamai Techs., Inc.*, 572 U.S. 915, 922 (2014) (“A method patent claims a number of steps; under this Court’s case law, the patent is not infringed unless all the steps are carried out.”). Yet, Plaintiff improperly contends that “[f]or ’442 claim 1, this means proving infringement requires showing one of the steps is actually performed, and all three steps are capable of being practiced.” P-Br. at 23. Plaintiff cites a case addressing how a system that is **not capable** of performing those steps when the conditions are met **cannot** infringe (because it will never perform those steps). *Interdigital Tech. Corp. v. Lenovo Holding Co.*, C.A. No. 19-1590-LPS, 2021 WL 1856937, at *5 (D. Del. May 10, 2021) (finding that the defendant’s process in *Lincoln* would never perform the contingent claim limitation step if condition (e) were true, and therefore finding no infringement). No case cited by Plaintiff is binding as to whether multiple conditional-claim limitations in method claims, as a matter of claim construction, must be practiced or not. *Cf. Lincoln Nat. Life Ins. Co. v. Transamerica Life Ins. Co.*, 609 F. 3d 1364, 1367–69 (Fed. Cir. 2010) (explaining (1) that Transamerica did **not challenge** the claim constructions on appeal, and (2) that Transamerica’s system could not infringe, notwithstanding the fact that the conditions of claim (e) were *never met*, because its systems were not programmed to meet the claim’s steps if those limitations were met).

Plaintiff argues that contingent-claim steps need not actually be performed when the condition is not present, but that direct infringement of the **method** claim hinges on the “capability” of the **system** to perform the method. This is contrary to law. *Ericsson*, 773 F.3d at 1219; *Limelight Networks*, 572 U.S. at 922. Under Plaintiff’s interpretation, even if none of the three conditions are met, the patent may nonetheless still be infringed. The indefiniteness issue of this claim stems from the fact that it is unclear whether a system performing the process is required to perform the method claim limitations when it is in an environment where one, two, or three of the conditions are not present. If this is not required and the contingent limitations are non-limiting when the condition is not met, the claim is invalid on its face because many prior-art systems received PPDU and determined if they are from the same BSS or not. Here, if the frames do not come from an overlapping BSS, Plaintiff’s interpretation suggests that *none* of the three conditional steps would need to actually be carried out, and an accused system may nonetheless still infringe even though it only “receiv[es] a first [PPDU]” and “determin[es] whether a basic service set (BSS) of the first PPDU is a BSS to which the first station belongs or a BSS to which the first station does not belong,” without meeting any other claimed steps. ’442 Patent, claim 1. This defies the requirement that method claims require actual performance of the method and not mere capability.

Plaintiff attempts to distinguish the requisite method steps recited in claim 8 from the steps recited in claim 1 by characterizing claim 8 as “system claim 8.” However, claim 8 recites functional/method limitations—for example, the functional/method limitations in the disputed claim phrase. Plaintiff’s characterization of “system claim 8” should not be permitted to rewrite the requisite functional/method limitations recited in claim 8.

If the Court is not inclined to find this term indefinite, it must still clarify whether none, all, or some of the contingent-claim limitations must be actually performed in order to practice the claim. Plaintiff's position that the prior-art methods must actually practice all of the steps, but that infringement may still occur when one (or none!) of the contingent steps is actually performed, is contrary to law and should be rejected. *Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1351 (Fed. Cir. 2001) ("A patent may not, like a 'nose of wax,' be twisted one way to avoid anticipation and another to find infringement.") (citation omitted).

E. U.S. Patent No. 9,912,513

1. "wherein at least a portion of the payload of the uplink frame is associated with the first guard interval length" (claim 1) / "wherein at least a portion of the payload of the uplink frame is associated with the first CP length" (claim 9) / "wherein at least a portion of the legacy header is associated with a second CP length" (claim 10) / "wherein at least a portion of the respective non-legacy header is associated with the first guard interval" (claim 16)

Defendants' Proposed Construction	Plaintiff's Proposed Construction
indefinite	plain and ordinary meaning

Plaintiff argues the claim phrases "use simple words." P-Br. 25. Yet, Plaintiff devotes more than five pages in an attempt to justify its construction. Plaintiff attempts to rewrite the claims, which the Federal Circuit has explained it cannot do. "[I]t is not [the Court's] function to rewrite claims to preserve their validity." *Synchronoss Techs.*, 987 F.3d at 1367 (quoting *Allen Eng'g Corp.*, 299 F.3d at 1349). FIG. 8 (which Plaintiff annotates) reinforces that the specification provides no insight into how at least a **portion** of the payload of the uplink frame is **associated with** a guard interval: the Figure and accompanying explanation do not convey to a POSITA **how** there is an association between the guard interval and the payload of the uplink frame, let alone **what** the relevant "portion" of the uplink frame might be.

The caselaw also supports Defendants. Although Plaintiff attempts to distinguish

Defendants’ caselaw, such as *Advanced Aerospace Techs., Inc. v. U.S.*, 124 Fed. Cl. 282 (2015), the case confirms that a combination of words—“outboard portion”—was ambiguous because it was not clear if the term referred to an “inboard” or “outboard” portion. So too here, it is not clear to what degree the “portion” at issue is, let alone how the “association” occurs that would circumscribe any such “portion.” Nor does *Niazi Licensing Corp v. St. Jude Med. S.C., Inc.*, 30 F. 4th 1339, 1347-50 (Fed. Cir. 2022), save the disputed phrases. That case involved terms such as “resilient” and “pliable,” which are not at issue here. *Id.* at 1349. That case makes clear that, to be patentable, “words or terms of degree ‘must provide objective boundaries for those of skill in the art’ in the context of the invention to be indefiniteness.” *Id.* Here, there are no boundaries for *how* the “portion” is determined (or “associated”), let alone what the boundaries are for the size and location of the “portion” within an uplink frame.

Plaintiff’s attempt to rewrite the claims should be rejected, and its references to the specification should be viewed as window dressing because they do not address how a POSITA would know what the phrase “at least a portion of the payload” is; nor does it explain what “associat[ion]” occurs in the claim.

F. U.S. Patent No. 10,020,919

1. **“determining exactly a number of the one or more station information fields in the NDPA...in response to determining that the number of the one or more station information fields in the NDPA is one, transmitting first Channel State Information (CSI) feedback in response to receiving the NDP” (claim 1) / “when the number of the one or more station information fields in the NDPA is greater than one... transmitting the first CSI feedback in response to receiving the first trigger frame” (claim 2) / “when the number of one or more station information fields in the NDPA is greater than one... transmitting second CSI feedback in response to receiving the second trigger frame” (claim 8) / “when a number of the one or more station information fields in the NDPA is one, receiving first Channel State Information (CSI) feedback transmitted in response to the NDP having only one station information field” (claim 11) / “when the number of the one or more station information fields in the NDPA is greater than one... receiving the first CSI feedback in response to transmitting the first trigger frame” (claim 12) / “when the number of one or more station information fields**

in the NDPA is greater than one... receiving second CSI feedback in response to transmitting the second trigger frame” (claim 19)

Defendants’ [MODIFIED] Proposed Construction	Plaintiff’s Proposed Construction
Claim 1: determining an exact value of a number of <u>the</u> one or more station information fields in the NDPA; in response to (i) determining that the value of the number is one, which indicates that there is only one station information field in the NDPA and (ii) receiving the NDP, transmitting first Channel State Information (CSI) feedback ~~to an access point~~ Claim 2: when the value of the number is two or more, which indicates that there are two or more station information fields in the NDPA, ... transmitting the first CSI feedback ~~to the access point~~ in response to receiving the first trigger frame Claim 8: when the value of the number is two or more, which indicates that there are two or more station information fields in the NDPA, ... transmitting second CSI feedback ~~to the access point~~ in response to receiving the second trigger frame Claim 11: when a station determines that the value of a number of the one or more station information fields is one, which indicates that there is only one station information field in the NDPA, receiving first Channel State Information (CSI) feedback transmitted in response to the NDP having only one station information field Claim 12: when the station determines that the value of the number is two or more, which indicates that there are two or more station information fields in the NDPA, ... receiving the first CSI feedback in response to transmitting the first trigger frame Claim 19: when the station determines that the value of the number is two or more, which indicates that there are two or more station information fields in the NDPA, ... receiving second CSI feedback in response to transmitting the second trigger frame If not construed as above, the claims are indefinite.	plain and ordinary meaning

Plaintiff requests plain-and-ordinary meanings but proffers a specific construction for the term “determining exactly a number of the one or more station information fields in the NDPA.”

See P-Br. at 32 (reproduced partially below with emphasis).

6 ('919) at 32:66-67. Upon receiving the NDPA frame, the STA "determin[es] exactly a number of the one or more station information fields." *Id.* at 33:1-2. As explained later in the claim, "the number of the one or more station information fields in the NDPA is the cardinality⁵ of the one or more station information fields in the NDPA." *Id.* at 33:8-10. In other words, the STA counts the number of station information fields in the NDPA, and that number is exactly the number of elements in the set made up of all the station information fields. If the STA "determine[es] that the number of station information fields in the NDPA is one," the STA transmits a feedback frame

Specifically, Plaintiff defines "determining exactly a number of the one or more station information fields" as "counting the number of station information fields in the one or more station information fields." *Id.* Plaintiff's admitted definition supports how this disputed phrase is circular, if not ambiguous (e.g., it devolves to "the number of the one or more station information fields is the number of the one or more station information fields).

As presented in Defendants' Opening Brief, dependent claims 2, 8, 12, and 19, particularly when they are read in conjunction with claims 1 and 11, are nonsensical and therefore indefinite. *See* Opening Brief at 27-28. For example, when reading claims 1 and 2 in conjunction, where there is one station information field (e.g., where the yellow highlighted condition in annotated claim 1 is met), a first CSI

1. A method performed by a wireless device, the method comprising:
 receiving a Null Data Packet Announcement (NDPA), the NDPA including one or more station information fields;
 determining exactly a number of the one or more station information fields in the NDPA;
 receiving a Null Data Packet (NDP); and
 in response to determining that the number of the one or more station information fields in the NDPA is one, transmitting first Channel State Information (CSI) feedback in response to receiving the NDP,
 wherein the number of the one or more station information fields in the NDPA is the cardinality of the one or more station information fields in the NDPA.
 2. The method of claim 1, further comprising:
 when the number of the one or more station information fields in the NDPA is greater than one:
 receiving a first trigger frame; and
 transmitting the first CSI feedback in response to receiving the first trigger frame.

feedback is transmitted (the red highlighted step). Then, moving to claim 2, where there are two or more station information fields (the green highlighted condition), the first feedback is transmitted (blue highlighted step). *Id.* It is easily seen that the yellow and green conditions are mutually exclusive. But this causes a problem—the blue highlighted step recites transmitting "the first CSI feedback," referring to the CSI feedback recited in the red step. But, if the blue step is performed (i.e., the green condition is met), the red step is not (i.e., the yellow condition is not

met). It is unclear how these transmission steps are related to each other and what actually causes the transmissions. The disputed claim phrases render claims 1, 2, 8, 11, 12, and 19 indefinite based on any construction.

2. “wherein the number of the one or more station information fields in the NDPA is the cardinality of the one or more station information fields in the NDPA” (claims 1, 11)

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
plain meaning: wherein the number of the one or more station information fields in the NDPA is the number of the one or more station information fields in the NDPA This plain meaning renders the claims indefinite.	plain and ordinary meaning Alternatively, "wherein the number of the one or more station information fields in the NDPA is the number of elements in the set of station information fields"

As discussed in Defendants’ Opening Brief, a POSITA would find the claim language ambiguous at least because: (i) the scope of “cardinality” is unclear from the claim language itself; and (ii) this disputed phrase is circular (e.g., it devolves to “the number of the one or more station information fields is the number of the one or more station information fields”). Notably, Plaintiff cites to dictionaries for the term “cardinality,” that provide different definitions for the term. See P-Br. at 32 n.5. Plaintiff Exhibit W states “the number of elements in a given mathematical set.” Yet, Plaintiff fails to explain how “the station information fields in the NDPA” are “a given mathematical set.” Plaintiff also fails to address how “a set or group” could include “one” or a singular station information field in the context of ’919 claims 1 and 11.

G. U.S. Patent No. 10,756,851

1. “scheduling extension” (claims 1, 2, 7, 8)

Defendants’ Proposed Construction	Plaintiff’s Proposed Construction
“an extension appended to the control field that is dedicated to including scheduling information”	plain and ordinary meaning: “an extension to the control field that includes scheduling information”

Plaintiff requests ordinary meanings but provides no evidence that the term has a plain-

and-ordinary meaning to a POSITA. Here, the disputed claim phrase does not appear in the '851 Specification. The '851 Specification instead mentions “extension” in the context of FIG. 13. There is an exception to the application of plain-and-ordinary meaning where the patentee disavows the full scope of the claim term during prosecution. *Golden Bridge Tech., Inc. v. Apple, Inc.*, 758 F.3d 1362, 1365-66 (Fed. Cir. 2014). Here, the prosecution history reinforces that the phrase “scheduling extension” added through an Amendment was in reference to FIG. 13. See Opening Brief, Exhibit 7A (March 25, 2020 Amendment). The claim phrase “scheduling extension” was added to address the claim rejection. See *id.*, ATLAS-00020531. Notably, rather than *any* additional extension, the inventors elected to further include “scheduling extension” with a specific purpose or function. At least in view of the inventors’ amendment choice in this regard, Defendants propose the word “dedicated” to capture the inventors’ lexicography. In addition, the inventors represented to the Examiner the scheduling extension was described by reference to FIG. 13 and its description of the “control field (e.g., 1300) that includes a control extension indication (e.g., 1311),” along with the corresponding control extension subfield (1320). *Id.* at ATLAS-00020536. The inventors’ claim amendments and arguments made during the prosecution are wholly consistent with Defendants’ construction.

III. CONCLUSION

For the reasons set forth above, the Court should adopt Defendants’ proposed constructions.

Date: March 16, 2023

Respectfully submitted,

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Corporation, and D-Link Corporation**

CERTIFICATE OF SERVICE

The undersigned certifies that on March 16, 2023, all counsel of record who are deemed to have consented to electronic service are being served with a copy of this document through the Court's CM/ECF system.

/s/ Mark D. Strachan
Mark D. Strachan

EXHIBIT LIST

Exhibit No.	Description
10A	File History of Provisional Appln. No. 62/137,138 (ATLAS-00004101 - ATLAS-00004131)
10B	File History of Provisional Appln. No. 62/140,349 (ATLAS-00004132 - ATLAS-00004160)

APPENDIX

EXHIBIT 10A



UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING DATE	OR PART UNIT	INVENTOR(S)	ATTORNEY NO.	NO. CLAIMS	INDUST. CLASS.
62/137,138	03/23/2015		130	A303AA-012300PV		

CONFIRMATION NO. 9069

FILING RECEIPT



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Date Mailed: 04/03/2015

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

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Applicant(s)

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Power of Attorney:

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 62/137,138**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

page 1 of 3

ATLAS-00004101

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-012300PV
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

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For further information see 37 CFR 1.33(a).

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-012300PV
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION		
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Application Information:

Title of the Invention	APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION		
Attorney Docket Number	A303AA-012300PV	Small Entity Status Claimed	☒
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-012300PV
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION		

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.
--

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	A303AA-012300PV
	Application Number	
Title of Invention	APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION	

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If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		
Name of the Deceased or Legally Incapacitated Inventor :		
If the Applicant is an Organization check here. ☒		
Organization Name	NEWRACOM, INC.	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-012300PV	
		Application Number		
Title of Invention	APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION			
Mailing Address Information:				
Address 1	9008 Research Drive			
Address 2				
City	Irvine	State/Province	CA	
Country i	US	Postal Code	92618	
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		Application Number	
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Attorney Docket Number: A303AA-012300PV
Client Reference Number: P15-041US0-P1

Provisional Patent Application

**APPARATUS AND METHODS FOR DOWNLINK MULTI-USER
TRANSMISSION**

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ATLAS-00004111

NEWTRACOM

INVENTION DISCLOSURE FORM

TITLE OF THE INVENTION: Apparatus and methods for downlink multi-user transmission

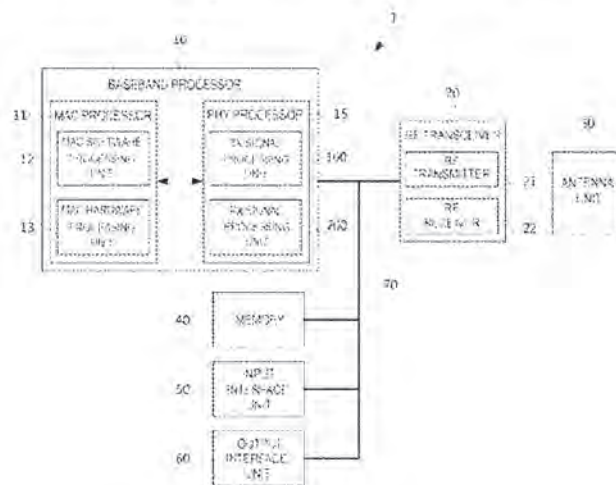
MOTIVATION OF THE INVENTION:

INVENTION DISCLOSURE FORM**DETAILED DESCRIPTION:**

In the following detailed description, only certain embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.

In a wireless local area network (WLAN), a basic service set (BSS) includes a plurality of WLAN devices. The WLAN device may include a medium access control (MAC) layer and a physical (PHY) layer according to IEEE (Institute of Electrical and Electronics Engineers) 802.11 standard. In the plurality of WLAN devices, at least one WLAN device may be an access point and the other WLAN devices may be non-AP stations (non-AP STAs). Alternatively, all the plurality of WLAN devices may be non-AP STAs in Ad-hoc networking. In general, the AP STA and the non-AP STA may be collectively called the STA. However, for easy description, only the non-AP STA may be called the STA.

The below drawing is a schematic block diagram exemplifying a WLAN device.



Referring the above drawing, the WLAN device 1 includes a baseband processor 10, a radio frequency (RF) transceiver 20, an antenna unit 30, a memory 40, an input interface unit 50, an output interface unit 60, and a bus 70.

The baseband processor 10 performs baseband signal processing, and includes a MAC processor 11 and a PHY processor 15.

In one embodiment, the MAC processor 11 may include a MAC software processing unit 12 and a MAC hardware processing unit 13. The memory 40 may store software (hereinafter referred to as "MAC software") including at least some functions of the MAC layer. The MAC software processing unit 12 executes the MAC software to implement the some functions of the MAC layer, and the MAC hardware processing unit 13 may implement remaining functions of the MAC layer as hardware (hereinafter referred to "MAC hardware"). However, the MAC processor 11 is not limited to this.

The PHY processor 15 includes a transmitting signal processing unit 100 and a receiving signal processing

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unit 200.

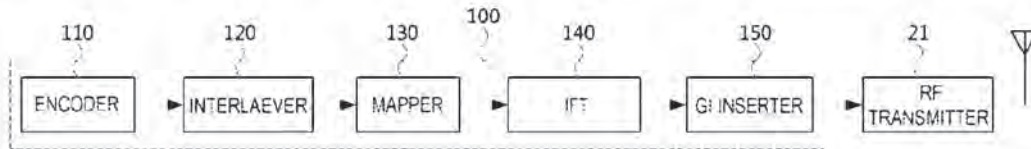
The baseband processor 10, the memory 40, the input interface unit 50, and the output interface unit 60 may communicate with each other via the bus 70.

The RF transceiver 20 includes an RF transmitter 21 and an RF receiver 22.

The memory may further store an operating system and applications. The input interface unit 50 receives information from a user, and the output interface unit 60 outputs information to the user.

The antenna unit 30 includes one or more antennas. When multiple-input multiple-output (MIMO) or multi-user MIMO (MU-MIMO) is used, the antenna unit 30 may include a plurality of antennas.

The below drawing is a schematic block diagram exemplifying a transmitting signal processor in a WLAN.



Referring the drawing, a transmitting signal processing unit 100 includes an encoder 110, an interleaver 120, a mapper 130, an inverse Fourier transformer (IFT) 140, and a guard interval (GI) inserter 150.

The encoder 110 encodes input data. For example, the encoder 100 may be a forward error correction (FEC) encoder. The FEC encoder may include a binary convolutional code (BCC) encoder followed by a puncturing device, or may include a low-density parity-check (LDPC) encoder.

The transmitting signal processing unit 100 may further include a scrambler for scrambling the input data before the encoding to reduce the probability of long sequences of 0s or 1s. If BCC encoding is used in the encoder, the transmitting signal processing unit 100 may further include an encoder parser for demultiplexing the scrambled bits among a plurality of BCC encoders. If LDPC encoding is used in the encoder, the transmitting signal processing unit 100 may not use the encoder parser.

The interleaver 120 interleaves the bits of each stream output from the encoder to change order of bits. Interleaving may be applied only when BCC encoding is used. The mapper 130 maps the sequence of bits output from the interleaver to constellation points. If the LDPC encoding is used in the encoder, the mapper 130 may further perform LDPC tone mapping besides the constellation mapping.

When the MIMO or the MU-MIMO is used, the transmitting signal processing unit 100 may use a plurality of interleavers 120 and a plurality of mappers corresponding to the number of N_{ss} of spatial streams. In this case, the transmitting signal processing unit 100 may further include a stream parser for dividing outputs of the BCC encoders or the LDPC encoder into blocks that are sent to different interleavers 120 or mappers 130. The transmitting signal processing unit 100 may further include a space-time block code (STBC) encoder for spreading the constellation points from the N_{ss} spatial streams into N_{sts} space-time streams and a spatial mapper for mapping the space-time streams to transmit chains. The spatial mapper may use direct mapping, spatial expansion, or beamforming.

The IFT 140 converts a block of the constellation points output from the mapper 130 or the spatial mapper to a time domain block (i.e., a symbol) by using an inverse discrete Fourier transform (IDFT) or an inverse fast Fourier transform (IFFT). If the STBC encoder and the spatial mapper are used, the inverse Fourier transformer 140 may be provided for each transmit chain.

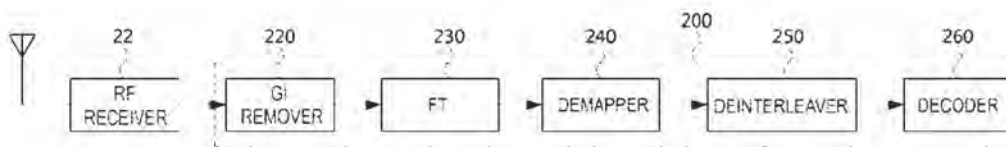
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When the MIMO or the MU-MIMO is used, the transmitting signal processing unit 100 may insert cyclic shift diversities (CSDs) to prevent unintentional beamforming. The CSD insertion may occur before or after the inverse Fourier transform. The CSD may be specified per transmit chain or may be specified per space-time stream. Alternatively, the CSD may be applied as a part of the spatial mapper.

When the MU-MIMO is used, some blocks before the spatial mapper may be provided for each user.

The GI inserter 150 prepends a GI to the symbol. The transmitting signal processing unit 100 may optionally perform windowing to smooth edges of each symbol after inserting the GI. The RF transmitter 21 converts the symbols into an RF signal and transmits the RF signal via the antenna unit 30. When the MIMO or the MU-MIMO is used, the GI inserter 150 and the RF transmitter 21 may be provided for each transmit chain.

The below drawing is a schematic block diagram exemplifying a receiving signal processing unit in the WLAN.



Referring to the drawing, a receiving signal processing unit 200 includes a GI remover 220, a Fourier transformer (FT) 230, a demapper 240, a deinterleaver 250, and a decoder 260.

An RF receiver 22 receives an RF signal via the antenna unit 30 and converts the RF signal into the symbols. The GI remover 220 removes the GI from the symbol. When the MIMO or the MU-MIMO is used, the RF receiver 22 and the GI remover 220 may be provided for each receive chain.

The FT 230 converts the symbol (i.e., the time domain block) into a block of the constellation points by using a discrete Fourier transform (DFT) or a fast Fourier transform (FFT). The Fourier transformer 230 may be provided for each receive chain.

When the MIMO or the MU-MIMO is used, the receiving signal processing unit 200 may include a spatial demapper for converting the Fourier transformed receiver chains to constellation points of the space-time streams, and an STBC decoder for despreading the constellation points from the space-time streams into the spatial streams.

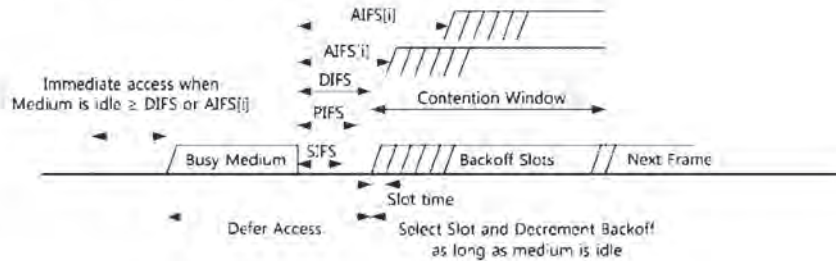
The demapper 240 demaps the constellation points output from the Fourier transformer 230 or the STBC decoder to the bit streams. If the LDPC encoding is used, the demapper 240 may further perform LDPC tone demapping before the constellation demapping. The deinterleaver 250 deinterleaves the bits of each stream output from the demapper 240. Deinterleaving may be applied only when BCC encoding is used.

When the MIMO or the MU-MIMO is used, the receiving signal processing unit 200 may use a plurality of demappers 240 and a plurality of deinterleavers 250 corresponding to the number of spatial streams. In this case, the receiving signal processing unit 200 may further include a stream deparser for combining the streams output from the deinterleavers 250.

The decoder 260 decodes the streams output from the deinterleaver 250 or the stream deparser. For example, the decoder 260 may be an FEC decoder. The FEC decoder may include a BCC decoder or an LDPC decoder. The receiving signal processing unit 200 may further include a descrambler for descrambling the decoded data. If BCC decoding is used in the decoder, the receiving signal processing unit 200 may further include an encoder deparser for multiplexing the data decoded by a plurality of BCC decoders. If LDPC decoding is used in the decoder, the receiving signal processing unit 200 may not use the encoder deparser.

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The below drawing exemplifies interframe space (IFS) relationships.

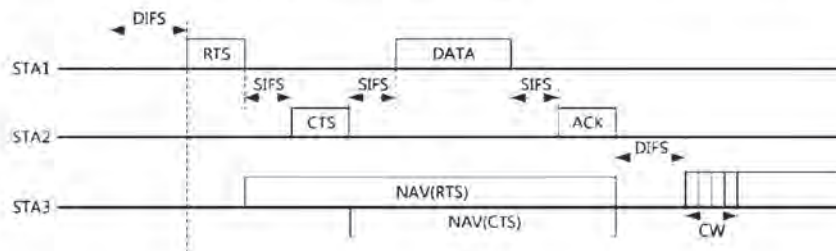


A data frame, a control frame, or a management frame may be exchanged between WLAN devices.

The data frame is used for transmission of data forwarded to a higher layer. The WLAN device transmits the data frame after performing backoff if a distributed coordination function IFS (DIFS) has elapsed from a time when the medium has been idle. The management frame is used for exchanging management information which is not forwarded to the higher layer. Subtype frames of the management frame include a beacon frame, an association request/response frame, a probe request/response frame, and an authentication request/response frame. The control frame is used for controlling access to the medium. Subtype frames of the control frame include a request to send (RTS) frame, a clear to send (CTS) frame, and an acknowledgement (ACK) frame. In the case that the control frame is not a response frame of the other frame, the WLAN device transmits the control frame after performing backoff if the DIFS has elapsed. In the case that the control frame is the response frame of the other frame, the WLAN device transmits the control frame without performing backoff if a short IFS (SIFS) has elapsed. The type and subtype of frame may be identified by a type field and a subtype field in a frame control field.

On the other hand, a Quality of Service (QoS) STA may transmit the frame after performing backoff if an arbitration IFS (AIFS) for access category (AC), i.e., AIFS[AC] has elapsed. In this case, the data frame, the management frame, or the control frame which is not the response frame may use the AIFS[AC].

The below drawing is a schematic diagram explaining a CSMA (carrier sense multiple access)/CA (collision avoidance) based frame transmission procedure for avoiding collision between frames in a channel.



Referring the drawing, STA1 is a transmit WLAN device for transmitting data, STA2 is a receive WLAN device for receiving the data, and STA3 is a WLAN device which may be located at an area where a frame transmitted from the STA1 and/or a frame transmitted from the STA2 can be received by the WLAN device.

The STA1 may determine whether the channel is busy by carrier sensing. The STA1 may determine the channel occupation based on an energy level on the channel or correlation of signals in the channel, or may determine the channel occupation by using a network allocation vector (NAV) timer.

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When determining that the channel is not used by other devices during DIFS (that is, the channel is idle), the STA1 may transmit an RTS frame to the STA2 after performing backoff. Upon receiving the RTS frame, the STA2 may transmit a CTS frame as a response of the CTS frame after SIFS.

When the STA3 receives the RTS frame, it may set the NAV timer for a transmission duration of subsequently transmitted frames (for example, a duration of SIFS + CTS frame duration + SIFS + data frame duration + SIFS + ACK frame duration) by using duration information included in the RTS frame. When the STA3 receives the CTS frame, it may set the NAV timer for a transmission duration of subsequently transmitted frames (for example, a duration of SIFS + data frame duration + SIFS + ACK frame duration) by using duration information included in the RTS frame. Upon receiving a new frame before the NAV timer expires, the STA3 may update the NAV timer by using duration information included in the new frame. The STA3 does not attempt to access the channel until the NAV timer expires.

When the STA1 receives the CTS frame from the STA2, it may transmit a data frame to the STA2 after SIFS elapses from a time when the CTS frame has been completely received. Upon successfully receiving the data frame, the STA2 may transmit an ACK frame as a response of the data frame after SIFS elapses.

When the NAV timer expires, the STA3 may determine whether the channel is busy by the carrier sensing. Upon determining that the channel is not used by the other devices during DIFS after the NAV timer has expired, the STA3 may attempt the channel access after a contention window according to random backoff elapses.

Downlink (DL) multi-user (MU) multiple-input-multiple-output (MIMO) procedure that is defined in IEEE 802.11ac specification is illustrated in the drawings below. In these drawings, there are two different acknowledgement schemes; (a) immediate acknowledgement to the VHT MU PPDU, and (b) no immediate acknowledgement to the VHT MU PPDU. In a DL MU-MIMO transmission with an immediate acknowledgement, an AP designate a specific STA to send back acknowledgement frame right after VHT MU PPDU. After receiving the acknowledgement frame from the specific STA, the AP polls acknowledgement frames from each STA that the AP has sent the VHT MU PPDU. However, in a DL MU-MIMO transmission with no immediate acknowledgement, an AP sets the Ack Policy for every STA to be a delayed ACK, and after sending VHT MU PPDU the AP polls acknowledgement frames from each STA that the AP has sent the VHT MU PPDU.

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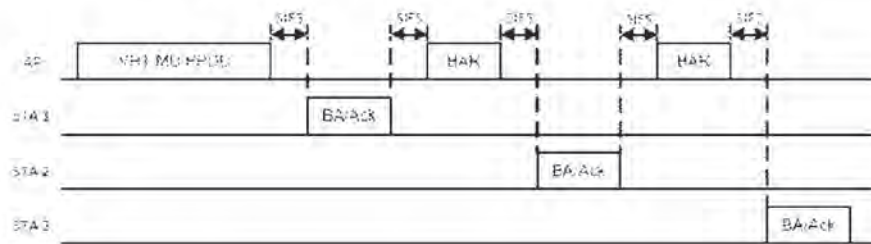


Figure 9-11—An example of a TXOP containing a VHT MU PPDU transmission with an immediate acknowledgment to the VHT MU PPDU

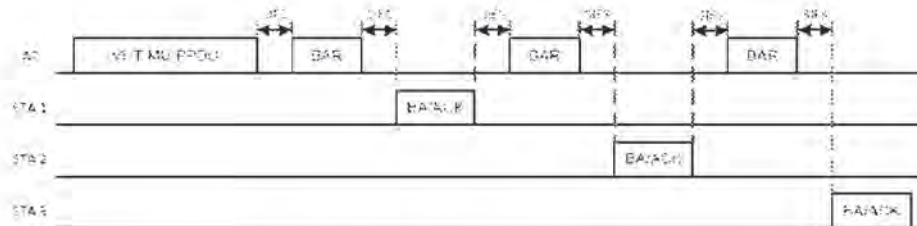


Figure 9-12—An example of a TXOP containing a VHT MU PPDU transmission with no immediate acknowledgment to the VHT MU PPDU

Therefore, for both mechanisms, even though DL data frames are sent in parallel (in spatial domain), the acknowledgement frames from multiple STAs are received in serial manner. In this case, as each serial transmission of acknowledgement frame needs BAR (Block Ack Request) frame and BA/ACK frame exchange, and as each exchange needs to be done in serial manner, the overhead for sending acknowledgement frames is significant, and thus, it reduces the overall gain of DL MU-MIMO. This mechanism was inevitable in IEEE 802.11ac protocol because IEEE 802.11ac standard does not define uplink multi-user simultaneous transmission.

However, as IEEE 802.11 standard further includes the concept of uplink multi-user simultaneous transmission, such as UL orthogonal frequency division multiple access (OFDMA) or UL-MIMO, it is possible to respond acknowledgement frames not in serial manner but in parallel fashion. In case UL MU simultaneous transmission is allowed for acknowledgement frame transmission in response to DL MU transmission, there are several issues that needs to be solved. One of the issues is that as there already exists an acknowledgement scheme in conventional protocol, in case new acknowledgement scheme is introduced to 802.11ax protocol, it will may confuse legacy STAs who cannot understand 802.11ax protocol, and thus, it is hard for 802.11ax STAs and legacy STAs to be scheduled together for DL MU transmission. For example, if legacy STAs and 802.11ax STAs are scheduled together for DL MU-MIMO transmission, due to support of legacy (VHT) STA, the frame format of DL MU PPDU shall be VHT MU PPDU, and in this case, there's no way to indicate acknowledgement scheme based on UL MU fashion.

One way of overcoming this problem is not to allow legacy STAs and new STAs to be scheduled together. For example, if DL MU PPDU is in new MU frame format that legacy STA doesn't support, only new acknowledgement frame transmission mechanism is used, and thus, only new STAs will be scheduled for this transmission. And, if DL MU PPDU is in VHT MU frame format that legacy STA supports, conventional polled-Ack mechanism is used, and thus, both legacy and new STAs can participate. However, in this case, the

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disadvantage of long overhead that polled-Ack mechanism inherently has cannot be overcome.

In this invention, we introduce several mechanisms that enable transmission of acknowledgement frames in UL MU manner, while maintaining backward compatibility such that both legacy STAs and new STAs can be scheduled together.

In the first approach, a specific method for acknowledgement frame transmission is further indicated in the MAC header, such that new STA can identify which method is supposed to be used while legacy STA will ignore the indication. For this purpose, conventional Ack policy subfield in QoS Control field in MAC header of a MU PPDU is reused to indicate the acknowledgement policy that is followed upon the delivery of the MPDU. Based on IEEE 802.11 standard the Ack Policy subfield is 2 bits in length and the interpretation of these 2 bits is given below.

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Table 8-9—Ack Policy subfield in QoS Control field of QoS Data frames

Bits in QoS Control field		Meaning
Bit 5	Bit 6	
0	0	Normal Ack or Implicit Block Ack Request In a frame that is a non-A-MPDU frame or VHT single MPDU: The addressed recipient returns an Ack as QoS +CF Ack frame after a short interframe space (SIFS) period, according to the procedures defined in 9.2.2.9 (Ack procedure) and 9.2.3.5 (HCCA transfer rules). A non-DMG STA sets the Ack Policy subfield for individually addressed QoS Null (no data) frames to this value. Otherwise: The addressed recipient returns a BlockAck frame, either individually or as part of an A-MPDU starting a SIFS after the PPDU carrying the frame, according to the procedures defined in 9.2.2.10 (Block ack procedure), 9.2.4.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA), 9.2.4.8.3 (Operation of HT-delayed block ack), 9.2.8.3 (Rules for RD initiators), 9.2.8.4 (Rules for RD responder), and 9.2.1.3 (Explicit feedback beamforming).
1	0	No Ack The addressed recipient takes no action upon receipt of the frame. More details are provided in 9.2.5 (No Acknowledgment (No Ack)). The Ack Policy subfield is set to this value in all individually addressed frames in which the sender does not require acknowledgment. The Ack Policy subfield is also set to this value in all group addressed frames that use the QoS frame format except with a TID for which a block ack agreement exists. This value of the Ack Policy subfield is not used for QoS Data frames with a TID for which a block ack agreement exists. The Ack Policy subfield for group addressed QoS Null (no data) frames is set to this value.
0	1	No explicit acknowledgment or PSMP Ack When bit 6 of the Frame Control field (see 8.2.4.1.3 (Type and Subtype field)) is set to 1: There may be a response frame to the frame that is received, but it is neither the Ack frame nor any Data frame of subtype +CF Ack. The Ack Policy subfield for QoS CF Poll and QoS CF Ack +CF Poll Data frames is set to this value. When bit 6 of the Frame Control field (see 8.2.4.1.3 (Type and Subtype field)) is set to 0: The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP downlink transmission time (PSMP-DTT) is to be received in a later PSMP uplink transmission time (PSMP-UTT). The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP-UTT is to be received in a later PSMP-DTT. NOTE—Bit 6 of the Frame Control field (see 8.2.4.1.3 (Type and Subtype field)) indicates the absence of a data payload. When equal to 1, the QoS Data frame contains no payload, and any response is generated in response to a QoS CF Poll or QoS CF-Ack +CF-Poll frame but does not signify an acknowledgment of data. When set to 0, the QoS Data frame contains a payload, which is acknowledged as described in 9.2.9.1.7 (PSMP acknowledgment rules).
1	1	Block Ack The addressed recipient takes no action upon the receipt of the frame except for recording the state. The recipient can expect a BlockAckReq frame in the future to which it responds using the procedure described in 9.2.4 (Block acknowledgment (block ack)).

When Ack Policy subfield is set a state to indicate immediate acknowledgement, which in current definition corresponds to "Normal Ack or Implicit Block Ack Request", another subfield (a first subfield) indicates if the following acknowledgement shall be a single user acknowledgement or a MU acknowledgement. Therefore, MU acknowledgement that follows immediately after MU PPDU transmission happens only from those STAs that Ack Policy subfield is set to immediate acknowledgement, and the first subfield is set to "MU

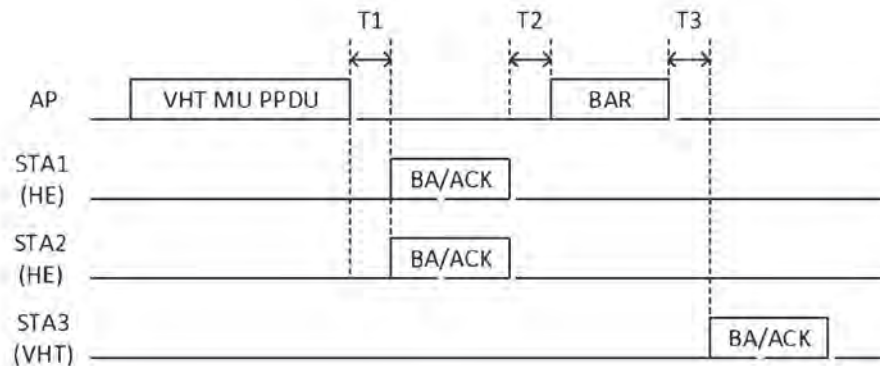
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acknowledgement”.

And, those STAs that Ack Policy subfield is set to immediate acknowledgement and the first subfield is not set to “MU acknowledgement” or cannot interpret the first subfield, will send conventional acknowledgement frame in single user transmission manner.

For legacy STAs to be included in the DL MU transmission together with new STAs under this approach, there are multiple ways to serve the legacy STAs. The first way is to set the Ack Policy subfield of the PPDU for the legacy STAs to a state that indicates delayed acknowledgement, which in current definition corresponds to “Block Ack” and follows the mechanism of no immediate acknowledgement to the VHT MU PPDU, which is illustrated above. The other way is to set the Ack Policy subfield of the PPDU for one of legacy STAs to immediate acknowledgement to be immediate acknowledgement, and to set the Ack Policy subfield of the PPDU for all other scheduled STAs including new STAs to be delayed acknowledgement.

One example of the proposed invention is illustrated in the below drawing. In this example, an AP transmits VHT MU PPDU using DL MU-MIMO to STA1, STA2, and STA3 simultaneously, wherein STA1 and STA2 is STAs that support UL MU transmission, and STA3 is a VHT STA that doesn't support UL MU transmission. In this case, the AP sets the Ack Policy subfield for both STA1 and STA2 to immediate acknowledgement and sets the first subfield to MU acknowledgement. Moreover, the AP sets the Ack Policy subfield for STA3 to delayed acknowledgement. Then, right after AP's downlink MU PPDU transmission, STA1 and STA2 transmits acknowledgement frame in UL MU manner, while STA3 waits until Block Ack Request frame is sent from the AP for its own acknowledgement frame transmission.



In one embodiment of this approach, QoS AP PS Buffer State subfield in QoS Control field is used as the first subfield.

In one idea of the above embodiment, 8th bit (B8) of the QoS AP PS Buffer State subfield is used as the indication of the first subfield.

In another embodiment of this approach, if the first subfield is set to MU acknowledgement state, resource allocation information regarding UL MU transmission follows pre-determined rule and no explicit indication on the resource allocation information regarding UL MU transmission is included in the DL MU PPDU.

In another embodiment of this approach, if the first subfield is set to MU acknowledgement state, there is a second part in the MU PPDU that comprises specific UL MU transmission methods for MU acknowledgement

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frame transmission.

In one idea of the above embodiment, UL MU transmission methods comprise UL OFDMA transmission.

In another idea of the above embodiment, UL MU transmission methods comprise UL MU-MIMO transmission.

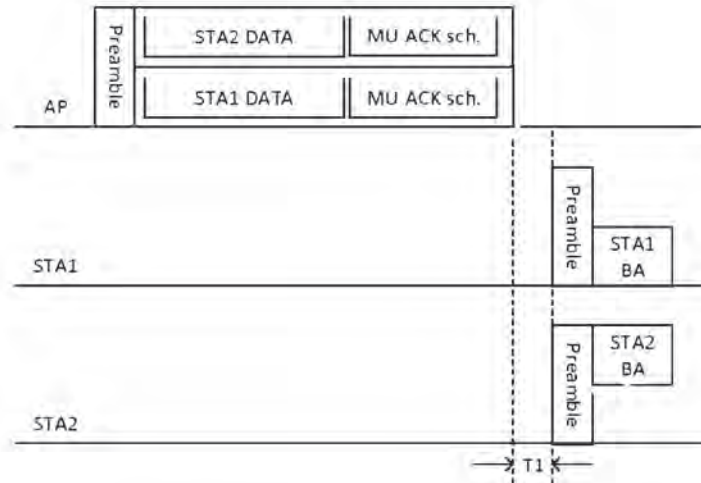
In another embodiment of this approach, if the first subfield is set to MU acknowledgement state, there is a second part in the MU PPDU that comprises resource allocation information for MU acknowledgement frame transmission.

In the second approach of the invention, each per-STA encoding block of DL MU PPDU comprises a scheduling information for UL MU acknowledgement frame transmission. For this purpose, DL aggregated MPDU (A-MPDU) for each STA participating immediate MU acknowledgement comprises an MPDU that indicates the UL resource for immediate MU acknowledgement. As legacy STA cannot participate UL MU acknowledgement, legacy STAs will be assigned for delayed acknowledgement, while new STAs can be assigned to immediate MU acknowledgement.

Ack Policy subfield in the QoS Control field of DM MU PPDU for all STAs scheduled for immediate MU acknowledgement is set to immediate acknowledgement to further indicate immediate acknowledgement.

The illustration below shows an example frame exchange using this approach. In this example, an AP schedules STA1 and STA2 for DL OFDMA transmission, wherein STA1 is allocated in the lower half of the transmission bandwidth and STA2 is allocated in the upper half of the transmission bandwidth. In this example, the AP's DL MU PPDU comprises two independent AMPDUs, wherein the first AMPDU is targeted to STA1 and the second AMPDU is targeted to STA2. And, each of AMPDU comprises an MPDU which includes UL MU acknowledgement scheduling information. The UL MU acknowledgement scheduling information indicates the resource allocation information for each STA's UL MU acknowledgement frame transmission, which follows predetermined time after receiving DL MU PPDU.

Each target receiver of DL MU PPDU receives the DL MU PPDU and checks the Preamble part of the frame, wherein the Preamble part indicates the allocated resource for each target receiver. Then, the target receiver decodes the PPDU that is allocated to the receiver and then can identify in which resource the receiver is allowed to send the UL acknowledgement frame. In a predetermined time after receiving the DL MU PPDU, the receiver sends UL acknowledgement frame in MU fashion, following the resource allocation that is given in the MU acknowledgement scheduling part of the received PPDU.

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In one embodiment, the scheduling information for UL MU acknowledgement frame transmission forms a MPDU, and the MPDU is aggregated with other DL data MPDUs of each scheduled STA in A-MPDU format.

In another embodiment, the scheduling information for UL MU acknowledgement frame transmission comprises a common information and a per-STA information, wherein the common information is information that every scheduling information for UL MU acknowledgement frame transmission for different STAs scheduled in the same DL MU PPDU is identical, and wherein the per-STA information is information that is specific resource allocation to each STA and thus different STAs scheduled in the same DL MU PPDU have different indication information.

In another embodiment, together with DL data MPDU, an AP sends a first MPDU in an AMPDU manner, wherein the first MPDU includes scheduling information for UL MU acknowledgement frame transmission.

In one idea of the above embodiment, a first STA that received the DL AMPDU and if the first STA is the target receiver of the DL AMPDU, the first STA sends acknowledgement frame in predetermined time after receiving the DL frame, wherein the acknowledgement frame is constructed based on the information in the first MPDU in the AMPDU.

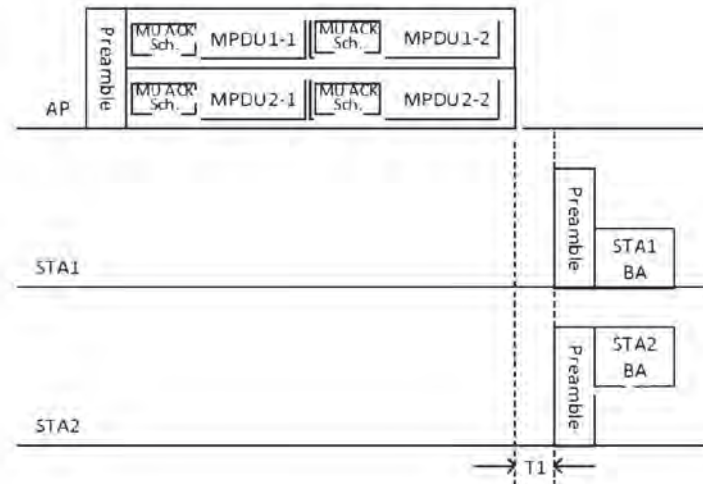
In the third approach of the invention, each per-STA encoding block of DL MU PPDU comprises a scheduling information for UL MU acknowledgement frame transmission. For this purpose, MAC header part within DL A-MPDU for each STA participating immediate MU acknowledgement frame transmission includes indication of the UL resource allocation information for immediate MU acknowledgement transmission. As legacy STA cannot participate UL MU acknowledgement, legacy STAs will be assigned for delayed acknowledgement, while new STAs can be assigned to immediate MU acknowledgement.

Ack Policy subfield in the QoS Control field of DM MU PPDU for all STAs scheduled for immediate MU acknowledgement is set to immediate acknowledgement to further indicate immediate acknowledgement.

The illustration below shows an example frame exchange using this approach. In this example, an AP schedules STA1 and STA2 for DL OFDMA transmission, wherein STA1 is allocated in the lower half of the

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transmission bandwidth and STA2 is allocated in the upper half of the transmission bandwidth. In this example, the AP's DL MU PPDU comprises two independent AMPDUs, wherein the first AMPDU is targeted to STA1 and the second AMPDU is targeted to STA2. And, MAC header part in every MPDU within the AMPDU comprises UL MU acknowledgement scheduling information. The UL MU acknowledgement scheduling information indicates the resource allocation information for each STA's UL MU acknowledgement frame transmission, which follows predetermined time after receiving DL MU PPDU.



In one embodiment of this approach, all MPDUs within the AMPDU of the DL MU PPDU for each scheduled STA have the scheduling information for UL MU acknowledgement frame transmission in the MAC header part.

In another embodiment of this approach, at least one of MPDUs within the AMPDU of the DL MU PPDU for each scheduled STA have the scheduling information for UL MU acknowledgement frame transmission in the MAC header part.

In another embodiment of this approach, HT Control field in the MAC header of MPDUs within the AMPDU of the DL MU PPDU for each scheduled STA has a first indication that the scheduling information for UL MU acknowledgement frame transmission is included, and when the first indication is set, the size of HT Control field is longer than the size of HT Control field when the first indication is not set.

In another embodiment, the scheduling information for UL MU acknowledgement frame transmission comprises a common information and a per-STA information, wherein the common information is information that every scheduling information for UL MU acknowledgement frame transmission for different STAs scheduled in the same DL MU PPDU is identical, and wherein the per-STA information is information that is specific resource allocation to each STA and thus different STAs scheduled in the same DL MU PPDU have different indication information.

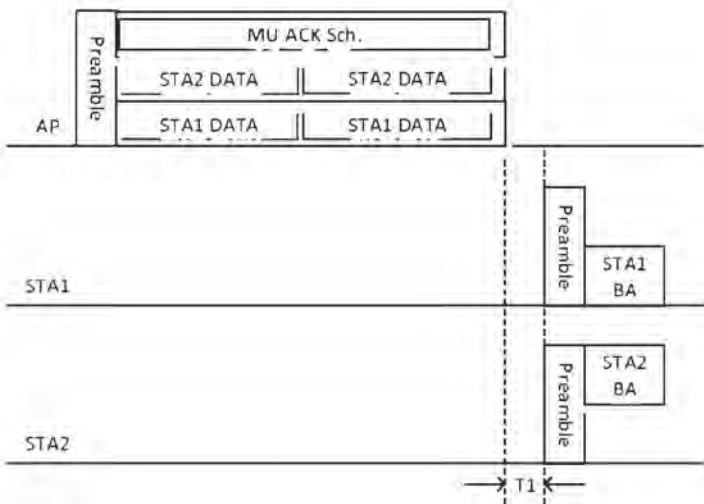
In the fourth approach of the invention, DL MU PPDU includes a first PPDU that is multicasted/broadcasted

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to at least those STAs that are scheduled for immediate MU acknowledgement transmission, wherein the first PPDU comprises indication of the UL resource allocation information for immediate MU acknowledgement transmission. As legacy STA cannot participate UL MU acknowledgement, legacy STAs will be assigned for delayed acknowledgement, while new STAs can be assigned to immediate MU acknowledgement.

Ack Policy subfield in the QoS Control field of DM MU PPDU for all STAs scheduled for immediate MU acknowledgement is set to immediate acknowledgement to further indicate immediate acknowledgement.

The illustration below shows an example frame exchange using this approach. In this example, an AP schedules STA1 and STA2 for DL OFDMA transmission, wherein STA1 is allocated in the lower most frequency resource of the transmission bandwidth and STA2 is allocated in the middle part of the transmission bandwidth. In this example, the AP's DL MU PPDU comprises three independent AMPDUs, wherein the first AMPDU is targeted to STA1 and the second AMPDU is targeted to STA2. And, the third AMPDU is multicasted/broadcasted to both STA1 and STA2, wherein the third AMPDU comprises UL MU acknowledgement scheduling information. The UL MU acknowledgement scheduling information indicates the resource allocation information for each STA's UL MU acknowledgement frame transmission, which follows predetermined time after receiving DL MU PPDU.



In one embodiment of this approach, scheduling information for UL MU acknowledgement frame transmission is multiplexed with DL MU data frame in OFDMA manner.

In another embodiment of this approach, the receiver address of the DL MU PPDU that comprises the scheduling information for UL MU acknowledgement frame transmission is set to an address that represents broadcast address.

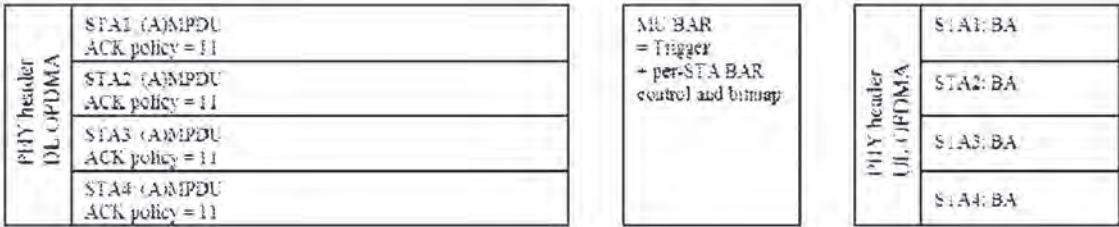
In another embodiment of this approach, the receiver address of the DL MU PPDU that comprises the scheduling information for UL MU acknowledgement frame transmission is set to an address that represents a group address that includes the target receivers of the DL MU PPDU.

In another embodiment of this approach, the modulation and coding scheme (MCS) level of the encoding

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block that includes the scheduling information for UL MU acknowledgement frame transmission is equal to or more robust than the MCS level of any of encoding blocks within the DL MU PPDU for STAs that are scheduled for immediate MU acknowledgement frame.

In the fifth approach of the invention, in case an AP needs to send acknowledgement in delayed manner, the AP can have BAR/BA sequence in MU simultaneous transmission. One example is shown in the drawing below:



In this example, the operation procedure is as follows: First, an AP sends data frames in DL MU way. Then, a first group of STAs send immediate ACK. Or a single VHT/HE STA might send legacy ACK/BA after SIFS time (This case is now shown in this figure for simplicity.) Then, the AP sends MU Block Ack Request (MU BAR) frame to a second group of STAs. The second group of STAs then send acknowledgement frames in UL MU way. And, for the second group of STAs, the Ack Policy is set to delayed acknowledgement.

For this approach, implementation of MU BAR frame transmission can have multiple different embodiments.

In one embodiment, a single MU BAR frame is constructed, wherein the MU BAR frame comprises BAR information for each scheduled STA and UL BA transmission scheduling information for each scheduled STA.

In another embodiment, an AP sends an AMPDU to each scheduled STA in DL MU transmission, and the AMPDU comprises the BAR information and the UL BA transmission scheduling information.

In another embodiment, an AP sends the following frames in DL MU transmission: 1) one BAR to each STA, and 2) one broadcast/multicast frame for UL MU BA transmission.

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ABSTRACT:

A specific method for acknowledgement frame transmission is further indicated in the MAC header, such that new STA can identify which method is supposed to be used while legacy STA will ignore the indication.

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION		
First Named Inventor/Applicant Name:		Young Hoon KWON		
Filer:		Steve Yong Soo Cho		
Attorney Docket Number:		A303AA-012300PV		
Filed as Small Entity				
Filing Fees for Provisional				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional Application Filing Fee	2005	1	130	130
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

ATLAS-00004128

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				130

ATLAS-00004129

Electronic Acknowledgement Receipt

EFS ID:	21851605
Application Number:	62137138
International Application Number:	
Confirmation Number:	9069
Title of Invention:	APPARATUS AND METHODS FOR DOWNLINK MULTI-USER TRANSMISSION
First Named Inventor/Applicant Name:	Young Hoon KWON
Customer Number:	83220
Filer:	Steve Yong Soo Cho
Filer Authorized By:	
Attorney Docket Number:	A303AA-012300PV
Receipt Date:	23-MAR-2015
Filing Date:	
Time Stamp:	20:28:27
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$130
RAM confirmation Number	7759
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Authorized User	CHO, STEVE Y.
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)	

ATLAS-00004130

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	2015_03_23_ADS_A303AA-012300PV.pdf	1560779 41e82b93164bba05215a061bc44eeb7c781346c	no	7
Warnings:					
Information:					
2	Specification	2015_03_23_SPEC_A303AA-012300PV.pdf	716189 26a4c56512dbb14261d8b77ca818a0d93a264c	no	17
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	29703 a0f548b61e9bba2c602570f03a0098b0d0311a46c	no	2
Warnings:					
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ATLAS-00004131

EXHIBIT 10B



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL.FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
62/140,349	03/30/2015		130	A303AA-013000PV		

CONFIRMATION NO. 7280

FILING RECEIPT



OC000000074550365

83220
 AMPACC Law Group, PLLC
 Steve Cho
 6100 219th Street SW, Suite 580
 Mountlake Terrace, WA 98043

Date Mailed: 04/13/2015

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

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Applicant(s)

NEWRACOM, INC., Irvine, CA

Power of Attorney:

Steve Cho-44612

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention is **US 62/140,349**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

page 1 of 3

ATLAS-00004132

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-013000PV
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Young Hoon		KWON	
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service				
City	Irvine	State/Province	CA	Country of Residence i US
Mailing Address of Inventor:				
Address 1		9008 Research Drive		
Address 2				
City	Irvine	State/Province	CA	
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Application Information:

Title of the Invention	APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES		
Attorney Docket Number	A303AA-013000PV	Small Entity Status Claimed	☒
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	
Filing By Reference :			

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-013000PV
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES		

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-013000PV	
		Application Number		
Title of Invention	APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES			
This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).				
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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.
--

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	A303AA-013000PV
	Application Number	
Title of Invention	APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES	

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

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☐ Person to whom the inventor is obligated to assign.	☐ Person who shows sufficient proprietary interest		
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Name of the Deceased or Legally Incapacitated Inventor :			
If the Applicant is an Organization check here. ☒			
Organization Name	NEWRACOM, INC.		
Mailing Address Information:			
Address 1	9008 Research Drive		
Address 2			
City	Irvine	State/Province	CA
Country ⁱ	US	Postal Code	92618
Phone Number		Fax Number	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-013000PV
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES		
Email Address			
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Assignee Information including Non-Applicant Assignee Information:

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Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
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If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
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First Name	Steve	Last Name	Cho	Registration Number
				44612
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	A303AA-013000PV
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Attorney Docket No.: A303AA-013000PV
Client Reference No.: P15-046US0-P1

PROVISIONAL PATENT APPLICATION

**APPARATUS AND METHODS FOR TRANSMITTING RESPONSE
FRAMES**

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ATLAS-00004142

NEWTRACOM

INVENTION DISCLOSURE FORM

TITLE OF THE INVENTION:

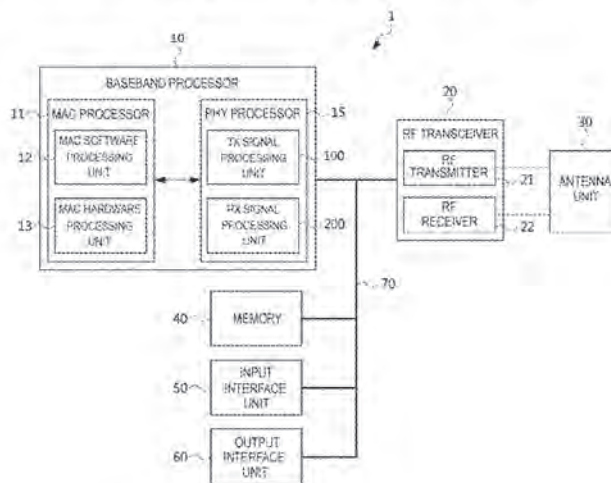
Apparatus and methods for transmitting response frames

INVENTION DISCLOSURE FORM**DETAILED DESCRIPTION:**

In the following detailed description, only certain embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.

In a wireless local area network (WLAN), a basic service set (BSS) includes a plurality of WLAN devices. The WLAN device may include a medium access control (MAC) layer and a physical (PHY) layer according to IEEE (Institute of Electrical and Electronics Engineers) 802.11 standard. In the plurality of WLAN devices, at least one WLAN device may be an access point and the other WLAN devices may be non-AP stations (non-AP STAs). Alternatively, all the plurality of WLAN devices may be non-AP STAs in Ad-hoc networking. In general, the AP STA and the non-AP STA may be collectively called the STA. However, for easy description, only the non-AP STA may be called the STA.

The below drawing is a schematic block diagram exemplifying a WLAN device.



Referring the above drawing, the WLAN device 1 includes a baseband processor 10, a radio frequency (RF) transceiver 20, an antenna unit 30, a memory 40, an input interface unit 50, an output interface unit 60, and a bus 70.

The baseband processor 10 performs baseband signal processing, and includes a MAC processor 11 and a PHY processor 15.

In one embodiment, the MAC processor 11 may include a MAC software processing unit 12 and a MAC hardware processing unit 13. The memory 40 may store software (hereinafter referred to as "MAC software") including at least some functions of the MAC layer. The MAC software processing unit 12 executes the MAC software to implement the some functions of the MAC layer, and the MAC hardware processing unit 13 may implement remaining functions of the MAC layer as hardware (hereinafter referred to "MAC hardware"). However, the MAC processor 11 is not limited to this.

The PHY processor 15 includes a transmitting signal processing unit 100 and a receiving signal processing

INVENTION DISCLOSURE FORM

unit 200.

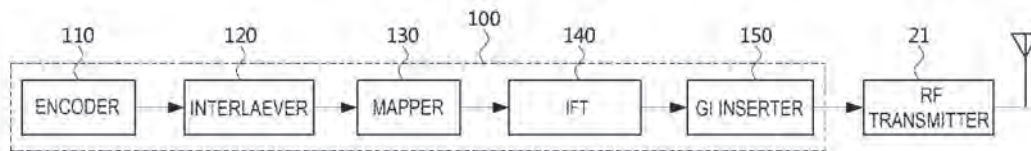
The baseband processor 10, the memory 40, the input interface unit 50, and the output interface unit 60 may communicate with each other via the bus 70.

The RF transceiver 20 includes an RF transmitter 21 and an RF receiver 22.

The memory may further store an operating system and applications. The input interface unit 50 receives information from a user, and the output interface unit 60 outputs information to the user.

The antenna unit 30 includes one or more antennas. When multiple-input multiple-output (MIMO) or multi-user MIMO (MU-MIMO) is used, the antenna unit 30 may include a plurality of antennas.

The below drawing is a schematic block diagram exemplifying a transmitting signal processor in a WLAN.



Referring the drawing, a transmitting signal processing unit 100 includes an encoder 110, an interleaver 120, a mapper 130, an inverse Fourier transformer (IFT) 140, and a guard interval (GI) inserter 150.

The encoder 110 encodes input data. For example, the encoder 100 may be a forward error correction (FEC) encoder. The FEC encoder may include a binary convolutional code (BCC) encoder followed by a puncturing device, or may include a low-density parity-check (LDPC) encoder.

The transmitting signal processing unit 100 may further include a scrambler for scrambling the input data before the encoding to reduce the probability of long sequences of 0s or 1s. If BCC encoding is used in the encoder, the transmitting signal processing unit 100 may further include an encoder parser for demultiplexing the scrambled bits among a plurality of BCC encoders. If LDPC encoding is used in the encoder, the transmitting signal processing unit 100 may not use the encoder parser.

The interleaver 120 interleaves the bits of each stream output from the encoder to change order of bits. Interleaving may be applied only when BCC encoding is used. The mapper 130 maps the sequence of bits output from the interleaver to constellation points. If the LDPC encoding is used in the encoder, the mapper 130 may further perform LDPC tone mapping besides the constellation mapping.

When the MIMO or the MU-MIMO is used, the transmitting signal processing unit 100 may use a plurality of interleavers 120 and a plurality of mappers corresponding to the number of N_{SS} of spatial streams. In this case, the transmitting signal processing unit 100 may further include a stream parser for dividing outputs of the BCC encoders or the LDPC encoder into blocks that are sent to different interleavers 120 or mappers 130. The transmitting signal processing unit 100 may further include a space-time block code (STBC) encoder for spreading the constellation points from the N_{SS} spatial streams into N_{STS} space-time streams and a spatial mapper for mapping the space-time streams to transmit chains. The spatial mapper may use direct mapping, spatial expansion, or beamforming.

The IFT 140 converts a block of the constellation points output from the mapper 130 or the spatial mapper to a time domain block (i.e., a symbol) by using an inverse discrete Fourier transform (IDFT) or an inverse fast Fourier transform (IFFT). If the STBC encoder and the spatial mapper are used, the inverse Fourier transformer 140 may be provided for each transmit chain.

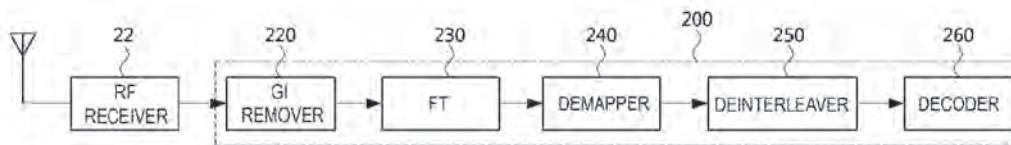
INVENTION DISCLOSURE FORM

When the MIMO or the MU-MIMO is used, the transmitting signal processing unit 100 may insert cyclic shift diversities (CSDs) to prevent unintentional beamforming. The CSD insertion may occur before or after the inverse Fourier transform. The CSD may be specified per transmit chain or may be specified per space-time stream. Alternatively, the CSD may be applied as a part of the spatial mapper.

When the MU-MIMO is used, some blocks before the spatial mapper may be provided for each user.

The GI inserter 150 prepends a GI to the symbol. The transmitting signal processing unit 100 may optionally perform windowing to smooth edges of each symbol after inserting the GI. The RF transmitter 21 converts the symbols into an RF signal and transmits the RF signal via the antenna unit 30. When the MIMO or the MU-MIMO is used, the GI inserter 150 and the RF transmitter 21 may be provided for each transmit chain.

The below drawing is a schematic block diagram exemplifying a receiving signal processing unit in the WLAN.



Referring to the drawing, a receiving signal processing unit 200 includes a GI remover 220, a Fourier transformer (FT) 230, a demapper 240, a deinterleaver 250, and a decoder 260.

An RF receiver 22 receives an RF signal via the antenna unit 30 and converts the RF signal into the symbols. The GI remover 220 removes the GI from the symbol. When the MIMO or the MU-MIMO is used, the RF receiver 22 and the GI remover 220 may be provided for each receive chain.

The FT 230 converts the symbol (i.e., the time domain block) into a block of the constellation points by using a discrete Fourier transform (DFT) or a fast Fourier transform (FFT). The Fourier transformer 230 may be provided for each receive chain.

When the MIMO or the MU-MIMO is used, the receiving signal processing unit 200 may include a spatial demapper for converting the Fourier transformed receiver chains to constellation points of the space-time streams, and an STBC decoder for despreads the constellation points from the space-time streams into the spatial streams.

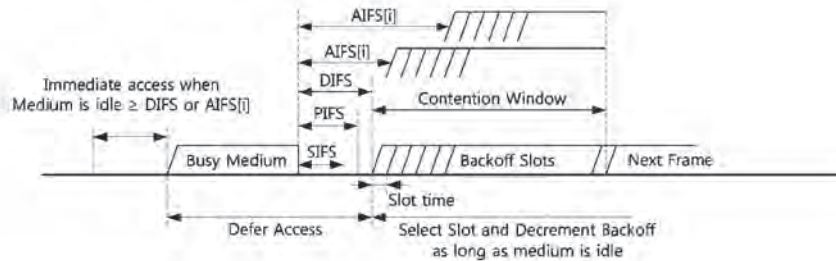
The demapper 240 demaps the constellation points output from the Fourier transformer 230 or the STBC decoder to the bit streams. If the LDPC encoding is used, the demapper 240 may further perform LDPC tone demapping before the constellation demapping. The deinterleaver 250 deinterleaves the bits of each stream output from the demapper 240. Deinterleaving may be applied only when BCC encoding is used.

When the MIMO or the MU-MIMO is used, the receiving signal processing unit 200 may use a plurality of demappers 240 and a plurality of deinterleavers 250 corresponding to the number of spatial streams. In this case, the receiving signal processing unit 200 may further include a stream deparser for combining the streams output from the deinterleavers 250.

The decoder 260 decodes the streams output from the deinterleaver 250 or the stream deparser. For example, the decoder 100 may be an FEC decoder. The FEC decoder may include a BCC decoder or an LDPC decoder. The receiving signal processing unit 200 may further include a descrambler for descrambling the decoded data. If BCC decoding is used in the decoder, the receiving signal processing unit 200 may further include an encoder deparser for multiplexing the data decoded by a plurality of BCC decoders. If LDPC decoding is used in the decoder, the receiving signal processing unit 100 may not use the encoder deparser.

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The below drawing exemplifies interframe space (IFS) relationships.

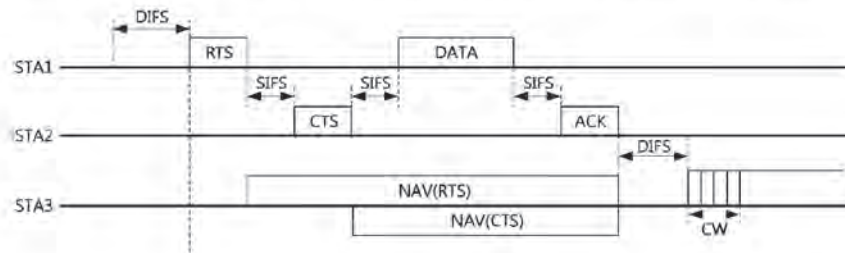


A data frame, a control frame, or a management frame may be exchanged between WLAN devices.

The data frame is used for transmission of data forwarded to a higher layer. The WLAN device transmits the data frame after performing backoff if a distributed coordination function IFS (DIFS) has elapsed from a time when the medium has been idle. The management frame is used for exchanging management information which is not forwarded to the higher layer. Subtype frames of the management frame include a beacon frame, an association request/response frame, a probe request/response frame, and an authentication request/response frame. The control frame is used for controlling access to the medium. Subtype frames of the control frame include a request to send (RTS) frame, a clear to send (CTS) frame, and an acknowledgement (ACK) frame. In the case that the control frame is not a response frame of the other frame, the WLAN device transmits the control frame after performing backoff if the DIFS has elapsed. In the case that the control frame is the response frame of the other frame, the WLAN device transmits the control frame without performing backoff if a short IFS (SIFS) has elapsed. The type and subtype of frame may be identified by a type field and a subtype field in a frame control field.

On the other hand, a Quality of Service (QoS) STA may transmit the frame after performing backoff if an arbitration IFS (AIFS) for access category (AC), i.e., AIFS[AC] has elapsed. In this case, the data frame, the management frame, or the control frame which is not the response frame may use the AIFS[AC].

The below drawing is a schematic diagram explaining a CSMA (carrier sense multiple access)/CA (collision avoidance) based frame transmission procedure for avoiding collision between frames in a channel.



Referring the drawing, STA1 is a transmit WLAN device for transmitting data, STA2 is a receive WLAN device for receiving the data, and STA3 is a WLAN device which may be located at an area where a frame transmitted from the STA1 and/or a frame transmitted from the STA2 can be received by the WLAN device.

The STA1 may determine whether the channel is busy by carrier sensing. The STA1 may determine the channel occupation based on an energy level on the channel or correlation of signals in the channel, or may determine the channel occupation by using a network allocation vector (NAV) timer.

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When determining that the channel is not used by other devices during DIFS (that is, the channel is idle), the STA1 may transmit an RTS frame to the STA2 after performing backoff. Upon receiving the RTS frame, the STA2 may transmit a CTS frame as a response of the CTS frame after SIFS.

When the STA3 receives the RTS frame, it may set the NAV timer for a transmission duration of subsequently transmitted frames (for example, a duration of SIFS + CTS frame duration + SIFS + data frame duration + SIFS + ACK frame duration) by using duration information included in the RTS frame. When the STA3 receives the CTS frame, it may set the NAV timer for a transmission duration of subsequently transmitted frames (for example, a duration of SIFS + data frame duration + SIFS + ACK frame duration) by using duration information included in the RTS frame. Upon receiving a new frame before the NAV timer expires, the STA3 may update the NAV timer by using duration information included in the new frame. The STA3 does not attempt to access the channel until the NAV timer expires.

When the STA1 receives the CTS frame from the STA2, it may transmit a data frame to the STA2 after SIFS elapses from a time when the CTS frame has been completely received. Upon successfully receiving the data frame, the STA2 may transmit an ACK frame as a response of the data frame after SIFS elapses.

When the NAV timer expires, the STA3 may determine whether the channel is busy by the carrier sensing. Upon determining that the channel is not used by the other devices during DIFS after the NAV timer has expired, the STA3 may attempt the channel access after a contention window according to random backoff elapses.

IEEE 802.11ac supports downlink (DL) multi-user (MU) multiple input multiple output (MIMO) scheme that an AP can send data frames to multiple STAs simultaneously using spatially different channel. The drawings below illustrate the operation of DL MU-MIMO transmission in 802.11ax standard. In these drawings, there are two different acknowledgement schemes; (a) immediate acknowledgement to the VHT MU PPDU, and (b) no immediate acknowledgement to the VHT MU PPDU. In a DL MU-MIMO transmission with an immediate acknowledgement, an AP designate a specific STA to send back acknowledgement frame right after VHT MU PPDU. After receiving the acknowledgement frame from the specific STA, the AP polls acknowledgement frames from each STA that the AP has sent the VHT MU PPDU. However, in a DL MU-MIMO transmission with no immediate acknowledgement, an AP sets the Ack Policy for every STA to be a delayed ACK, and after sending VHT MU PPDU the AP polls acknowledgement frames from each STA that the AP has sent the VHT MU PPDU.

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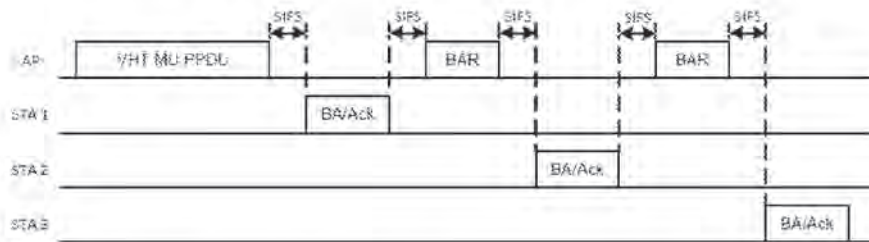


Figure 9-11—An example of a TXOP containing a VHT MU PPDU transmission with an immediate acknowledgment to the VHT MU PPDU

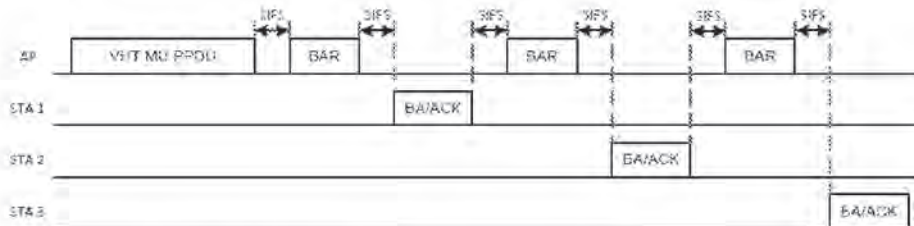


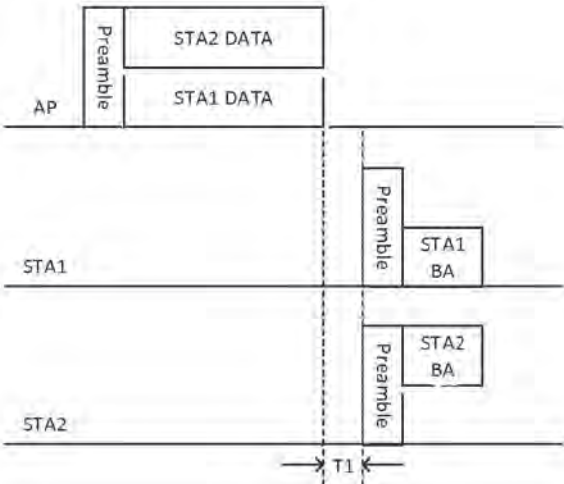
Figure 9-12—An example of a TXOP containing a VHT MU PPDU transmission with no immediate acknowledgment to the VHT MU PPDU

Therefore, for both mechanisms, even though DL data frames are sent in parallel (in spatial domain), the acknowledgement frames from multiple STAs are received in serial manner. In this case, as each serial transmission of acknowledgement frame needs BAR (Block Ack Request) frame and BA/ACK frame exchange, and as each exchange needs to be done in serial manner, the overhead for sending acknowledgement frames is significant, and thus, it reduces the overall gain of DL MU-MIMO. This mechanism was inevitable in IEEE 802.11ac protocol because IEEE 802.11ac standard does not define uplink multi-user simultaneous transmission.

Furthermore, IEEE 802.11ax supports DL MU transmission schemes more broadly which includes DL MU-MIMO and DL orthogonal frequency division multiple access (DL OFDMA) schemes. And, IEEE 802.11ax also supports uplink (UL) MU transmission schemes such as UL MU-MIMO and UL OFDMA, where multiple STAs can send simultaneously to the same AP. As IEEE 802.11ax standard further includes the concept of uplink multi-user simultaneous transmission, it is possible to respond acknowledgement frames not in serial manner but in parallel fashion. The drawing below illustrates DL OFDMA transmission with UL OFDMA response. In this example, an AP transmits data frames to STA1 and STA2 simultaneously using DL OFDMA technique. The AP allocates radio resource of lower channel bandwidth to STA1 and radio resource of upper channel bandwidth to STA2, and transmits data frames simultaneously. Then, after receiving the AP's data frames, both STA1 and STA2 may send acknowledgement frames in UL OFDMA manner. Both STA1 and STA2 can identify their allocated resource for acknowledgement frame transmission based on the received frame, and thus, STA1 and STA2 send their acknowledgement frames in predetermined time (T1) after receiving the DL OFDMA frame. In this example, STA1's allocated resource for Block Ack frame (BA) transmission is the lower half of the channel bandwidth and STA2's allocated resource for BA transmission is the upper half of the channel bandwidth. Also, at least part of UL preamble part occupies the whole channel

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bandwidth and both STA1 and STA2 sends with identical information, such that the signal from STA1 and STA2 are combined together in the air. As the acknowledgement frames for DL data transmission is transmitted in parallel from STA1 and STA2, this mechanism can reduce acknowledgement overhead.



However, multiplexing acknowledgement frames together in OFDMA manner have several technical issues that need to be resolved. One of the issues is that multiplexed acknowledgement frames cannot use non-HT frame format because non-HT frame format does not support MU transmission such as MU-MIMO and OFDMA. Therefore, in IEEE 802.11ax standard, the multiplexed acknowledgement frames shall use HE frame format.

The drawing below illustrates an example of an HE frame format. In this figure, Legacy preamble implies fields that are needed to support backward compatibility such as L-STF, L-LTF, and L-SIG. HE-SIG field includes information required to interpret HE PPDU, and it consists of at least HE-SIG-A field and optionally additional field can exist such as HE-SIG-B field. The size of HE-SIG-A field is fixed and HE-SIG-A field indicates common control information. HE-SIG-B field comprises per-STA specific information. After HE-SIG fields, HE-STF/LTF fields follow, wherein HE-STF/LTF fields are needed for AGC setting, frequency offset compensation, channel estimation etc. And, the HE-LTF section shall start at the same point of time and end at the same point of time across all users in case of MU transmission.

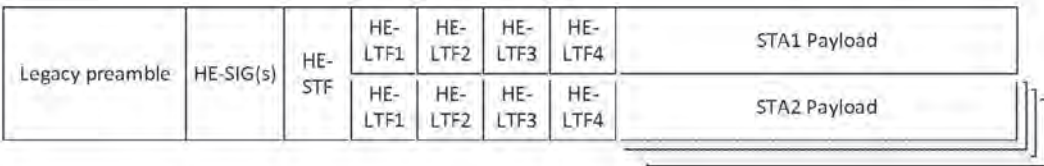
Legacy preamble	HE-SIG(s)	HE-STF	HE-LTF(s)	Payload
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In case of UL MU transmission, an UL MU PPDU (MU-MIMO or OFDMA) is sent as an immediate response to a trigger frame sent by an AP. As mentioned before, the legacy preamble part of UL MU part are combined together in the air, all the participating STAs have to have the same information on this part, and this is available as all the participating STAs will use the information that is seen in the trigger frame received right before sending the UL MU PPDU. For this reason, per-STA information in HE-SIG fields can also be removed

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as the target receiver of the UL MU PPDU already knows the information. Therefore, HE-SIG-B field of the HE PPDU can be omitted. As there's no HE-SIG-B field exists, there will not be an explicit indication of per-STA information such as bandwidth, modulation and coding scheme (MCS), number of space-time streams (NSTS), in the preamble part of UL MU PPDU.

In normal UL MU transmission that is sent as an immediate response to a DL trigger frame, because the trigger frame includes per-STA information such as MCS/NSTS/duration information for every STA, it is easily possible for each participating STA to identify how many LTFs to be used for the UL MU PPDU, wherein the number of HE-LTF symbols of a UL MU PPDU is equal to or greater than the maximum number of required HE-LTF symbols for all participating STA's transmission. The drawing below illustrates one example on the number of required HE-LTF symbols. In this example, STA1 and STA2 are allocated for MU transmission, wherein STA1 occupies the upper half of the channel bandwidth and STA2 occupies the lower half of the channel bandwidth. Also, NSTS for STA1 is 1 and NSTS for STA2 is 4. In this case, to align the starting and end point of HE-LTF field for both STAs, the number of HE-LTF symbols is set to 4, which is the maximum of required NSTS for STA1 and STA2.



However, in case acknowledgement frame is sent in UL MU manner in response to DL MU transmission, as there is no trigger frame existing, it's hard for each STA to figure out other STA's transmission information. Therefore, it is hard for each STA to identify NSTS of the acknowledgement frame.

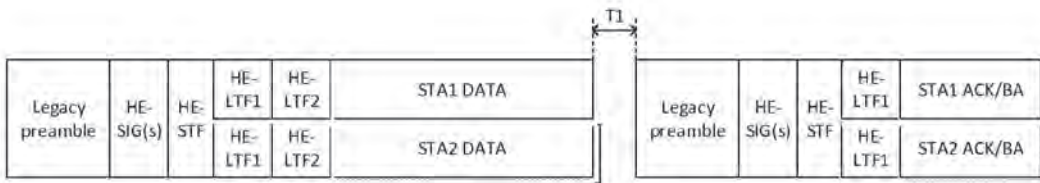
To overcome this problem in acknowledgement frame transmission in response to DL MU frame transmission, this invention discloses mechanisms that selects MCS and number of spatial streams (or space-time streams) for transmitting response frames.

The basic concept of the proposed invention is that if a control response frame is to be transmitted in UL MU PPDU, the number of spatial streams (or space-time streams) per STA shall be limited to 1. Therefore, every STA participating UL MU transmission in response to DL MU transmission will send ACK/BA frame with having same number of HE-LTF symbol regardless of other participating STA's channel condition. And, HE-LTF section of ACK/BA frame can start and end at the same time point without knowing other STA's condition.

This basic concept can be achieved in multiple variant ways. Some of the variants are described here. However, embodiments mentioned here does not limit the applicability of the basic concept of the proposed invention.

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In one embodiment (E1), if a control response frame is to be transmitted in UL MU manner, all participating STAs transmit the control response frame in predetermined time (T1) after receiving an eliciting frame with setting the number of HE-LTF symbols to a value corresponding to a single space-time stream, wherein the HE-LTF symbols provide a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs and the receive chain. The following illustration shows an example of this embodiment. In this example, an AP transmits data frames to STA1 and STA2 in DL OFDMA manner, wherein STA1's data is assigned to the upper half of the channel bandwidth and STA2's data is assigned to the lower half of the channel bandwidth. And, due to different channel condition, the AP uses single stream transmission to STA1 and 2 streams transmission (spatial multiplexing) to STA2. To align the transmission time the AP uses HE-LTF symbols corresponding to 2 stream transmission (in this case number of HE-LTF symbols equals to 2) for both STA1 and STA2.



After successful decoding of the DL OFDMA frame, STA1 and STA2 sends back acknowledgement (ACK or BA) frame in OFDMA manner a predetermined time (T1) after receiving the DL OFDMA frame. When STA1 and STA2 construct the acknowledgement frame in OFDMA manner, the number of HE-LTF symbols is set to a value corresponding to a single space-time stream (In this case the number of HE-LTF symbols equal to 1).

In another embodiment, in the idea of the above embodiment (E1), the predetermined time T1 is set to SIFS time in IEEE 802.11 standard.

In another embodiment, in the idea of the above embodiment (E1), the value corresponding to a single space-time stream equals to 1.

In another embodiment, in the idea of the above embodiment (E1), the value corresponding to a single space-time stream equals to 2.

In another embodiment, in the idea of the above embodiment (E1), Space-Time-Block-Coding (STBC) shall be disabled for the acknowledgement frame transmission.

In another embodiment (E2), in the idea of the above embodiment (E1), a first value is indicated by the transmitter of the eliciting frame as the length of the control response frame, and the MCS of the control response frame is set such that the length of the control response frame is not greater than the first value.

In another embodiment, in the idea of the above embodiment (E2), the first value is included in the eliciting frame.

In another embodiment (E3), in the idea of the above embodiment (E2), the first value is indicated before sending the eliciting frame.

In another embodiment (E4), in the idea of the above embodiment (E3), the first value is included in a first management frame sent by the transmitter of the eliciting frame.

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In another embodiment, in the idea of the above embodiment (E4), the first management frame is a Beacon frame.

In another embodiment, in the idea of the above embodiment (E4), the first management frame is a Probe Response frame.

In another embodiment, in the idea of the above embodiment (E4), the first management frame is an Association Response frame.

In another embodiment (E5), if a control response frame is to be transmitted in UL MU manner, an MCS shall be selected from a first set, wherein the MCS defines modulation/coding schemes and the number of space-time streams, wherein the number of space-time streams of the first set is limited to 1.

In another embodiment, in the idea of the above embodiment (E5), all <VHT-MCS, NSS> tuples defined in IEEE 802.11ac standard are further eliminated from the first set.

In another embodiment, in the idea of the above embodiment (E5), all MCSs that have a data rate greater than the data rate of the eliciting PPDU are further eliminated from the first set.

In another embodiment, in the idea of the above embodiment (E5), a transmitter of an eliciting frame for the control response frame further informs information related to the length of the control response frame, and all MCSs that the length of the encoded control response frame exceeds the informed length of the control response frame are further eliminated from the first set.

In another embodiment, in the idea of the above embodiment (E5), all MCSs that do not meet certain criteria are further eliminated from the first set, and if the first set is empty, the MCS shall be selected from a second set.

In another embodiment (E6), if a control response frame is to be transmitted in UL MU manner, all participating STAs transmit the control response frame in predetermined time (T1) after receiving an eliciting frame with setting the number of HE-LTF symbols to a second value, wherein the second value is indicated by the transmitter of the eliciting frame, and wherein the HE-LTF symbols provide a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs and the receive chain.

In another embodiment, in the idea of the above embodiment (E6), the predetermined time T1 is set to SIFS time in IEEE 802.11 standard.

In another embodiment (E7), in the idea of the above embodiment (E6), a first value is indicated by the transmitter of the eliciting frame as the length of the control response frame, and the MCS of the control response frame is set such that the length of the control response frame is not greater than the first value.

In another embodiment, in the idea of the above embodiment (E7), the first value is included in the eliciting frame.

In another embodiment (E8), in the idea of the above embodiment (E7), the first value is indicated before sending the eliciting frame.

In another embodiment (E9), in the idea of the above embodiment (E8), the first value is included in a first management frame sent by the transmitter of the eliciting frame.

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In another embodiment, in the idea of the above embodiment (E9), the first management frame is a Beacon frame.

In another embodiment, in the idea of the above embodiment (E9), the first management frame is a Probe Response frame.

In another embodiment, in the idea of the above embodiment (E9), the first management frame is an Association Response frame.

In another embodiment, in the idea of the above embodiment (E6), the second value is included in the eliciting frame.

In another embodiment (E7), in the idea of the above embodiment (E6), the second value is indicated before sending the eliciting frame.

In another embodiment (E8), in the idea of the above embodiment (E7), the second value is included in a first management frame sent by the transmitter of the eliciting frame.

In another embodiment, in the idea of the above embodiment (E8), the second management frame is a Beacon frame.

In another embodiment, in the idea of the above embodiment (E8), the second management frame is a Probe Response frame.

In another embodiment, in the idea of the above embodiment (E8), the second management frame is an Association Response frame.

In another embodiment (E9), if a control response frame is to be transmitted in UL MU manner, an MCS shall be selected from a first set, wherein the MCS defines modulation/coding schemes and the number of space-time streams, wherein the number of space-time streams of the first set is limited to a second value.

In another embodiment, in the idea of the above embodiment (E9), information on the second value is included in the eliciting frame.

In another embodiment, in the idea of the above embodiment (E9), the second value is indicated before sending the eliciting frame.

In another embodiment (E10), in the idea of the above embodiment (E9), the second value is included in a first management frame sent by the transmitter of the eliciting frame.

In another embodiment, in the idea of the above embodiment (E10), the second management frame is a Beacon frame.

In another embodiment, in the idea of the above embodiment (E10), the second management frame is a Probe Response frame.

In another embodiment, in the idea of the above embodiment (E10), the second management frame is an Association Response frame.

In another embodiment, in the idea of the above embodiment (E9), all <VHT-MCS, NSS> tuples defined in IEEE 802.11ac standard are further eliminated from the first set,

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In another embodiment, in the idea of the above embodiment (E9), all MCSs that have a data rate greater than the data rate of the eliciting PPDU are further eliminated from the first set.

In another embodiment, in the idea of the above embodiment (E9), a transmitter of an eliciting frame for the control response frame further informs information related to the length of the control response frame, and all MCSs that the length of the encoded control response frame exceeds the informed length of the control response frame are further eliminated from the first set.

In another embodiment, in the idea of the above embodiment (E9), determine the highest number of spatial streams (or space-time streams) value of the MCS in the first set is less than or equal to a third number of spatial streams (or space-time streams) value of the received frame, and eliminate all MCSs from the first set that have the number of spatial streams (or space-time streams) value that is not equal to the third number of streams.

In another embodiment, in the idea of the above embodiment (E9), all MCSs that do not meet certain criteria are further eliminated from the first set, and if the first set is empty, the MCS shall be selected from a second set.

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ABSTRACT:

The basic concept of the proposed invention is that if a control response frame is to be transmitted in UL MU PPDU, the number of spatial streams (or space-time streams) per STA shall be limited to 1. Therefore, every STA participating UL MU transmission in response to DL MU transmission will send ACK/BA frame with having same number of HE-LTF symbol regardless of other participating STA's channel condition. And, HE-LTF section of ACK/BA frame can start and end at the same time point without knowing other STA's condition.

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Application Number:				
Filing Date:				
Title of Invention:		APPARATUS AND METHODS FOR TRANSMITTING RESPONSE FRAMES		
First Named Inventor/Applicant Name:		Young Hoon KWON		
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	2015_03_30_ADS_A303AA-013000PV.pdf	1560690 (93ca2d13c24023da7c6f0ba6f9ddaf8f97a9b)	no	7
Warnings:					
Information:					
2	Specification	2015_03_30_SPEC_A303AA-013000PV.pdf	588526 e0b075c4dc212a1726a0e093f040a504b0176	no	15
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	29768 00bd7a10014d1ea300c2c0f7f03e0235ee0b57c	no	2
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